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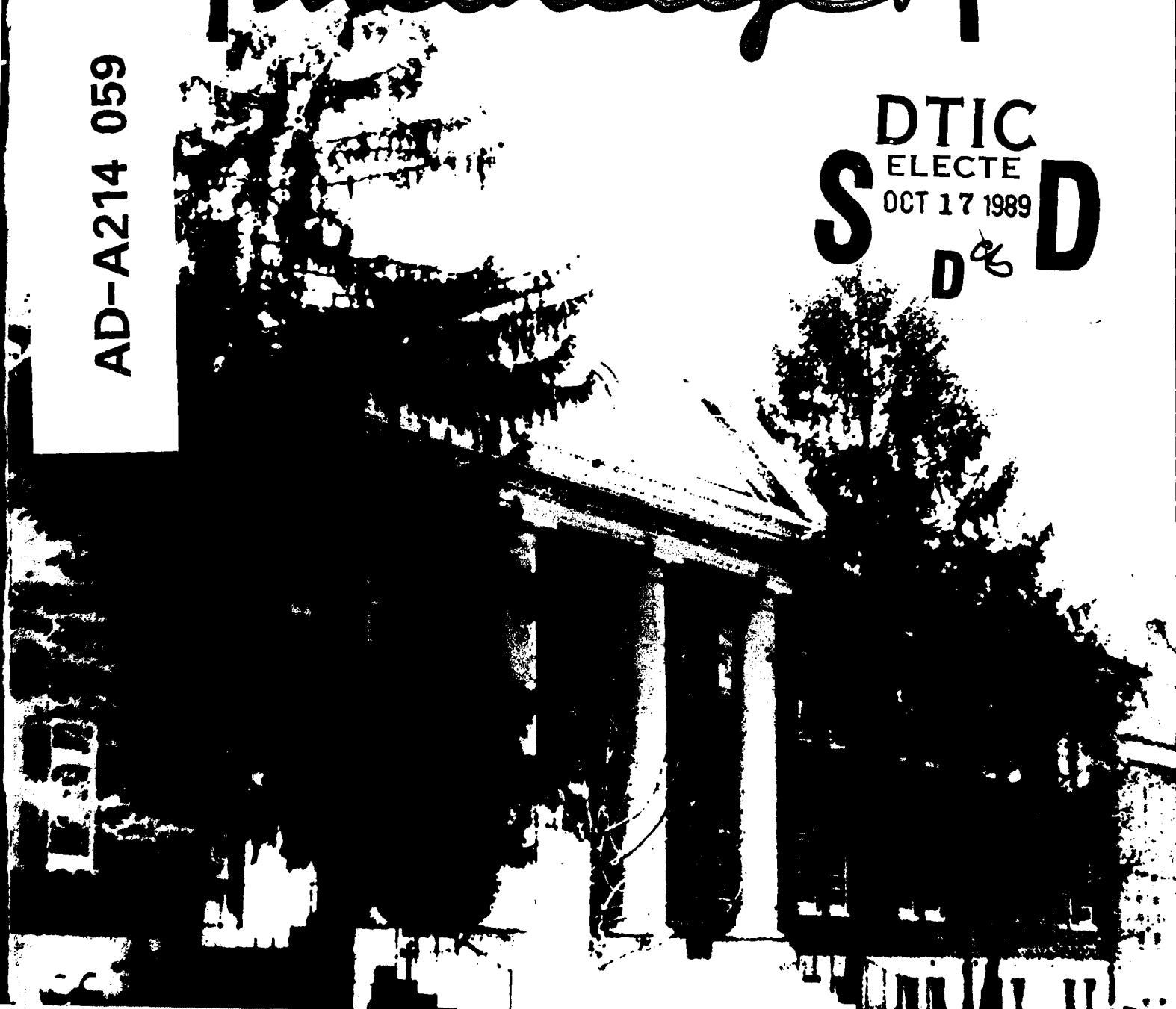
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Budget In POLITICS, ECONOMICS

For many years "budget instability" has been considered the cause of sizeable inefficiencies in performing Department of Defense business. Former Secretary of Defense Frank Carlucci used various forums to expand on this idea: Budget instability precludes the Department of Defense (DOD) from organizing and executing its programs in an optimally efficient way, thus sub-optimizing use and returns of funds spent by the department. In his last report to the Congress, Secretary Carlucci said:

Without steady, moderate funding growth we can neither protect our gains nor guarantee that our weakened defense posture can support our security commitments...congressional micromanagement has precluded the Department from receiving the necessary level of defense resources on a timely basis...has often hindered our flexibility in allocating resources and executing programs in ways designed to improve efficiency and effectiveness.¹

However, neither facts causing budget instability nor mechanisms whereby that "budget instability" translates itself into inefficiency have been clearly established. A need exists to restate this political argument in terms that are valid operationally. If budget instability exists and causes inefficiency, both can be measured and the causative process can be logically described. Only when this is accomplished can measures to alleviate or cure the undesirable effects of budget instability be effected.

Budget instability can be defined in different ways. Precise definition—an operational definition—is necessary before any meaningful discussion takes place, since the definition

determines what is to be measured and, to a large extent, how it is to be measured. Secretary Carlucci's statement notes two sides to instability: lack of steady, moderate growth in funding and congressional micromanagement.

To keep the discussion within the limited space of this article, I will not address in detail the issue of funding growth, even though I will discuss some political, economic and administrative issues involved. This paper will concentrate on the second side of budget instability, congressional micromanagement.

Accordingly, I define budget instability as the likelihood that the budget estimates submitted to the Congress by the Department of Defense will be materially changed by the appropriation process; that is, the difference between the initial budget *request* and the *actual* funds approved for the account.² Thus, I will discuss incidentally, but not address as "budget instability," up-and-down changes in "topline," the total Department of Defense budget authority requested for a given year, or years.

Neither will I discuss congressional failure to provide for steady growth of the funding available to the Department of Defense or to fund DOD at the level projected by the Five Year Defense Plan; that is, effects of having to accommodate within reduced "budget control numbers" the more optimistic estimates customarily carried on the Five Year Defense Plan.

I will not discuss budget escalation. Throughout the period covered by this paper, budgeted escalation (percentage growth allowed in estimates for inflation) was prescribed by the Office of Management and Budget (OMB) and the Office of the Secretary of Defense (Comptroller). Actual inflation turned out to be, in many years, significantly different from that allowed in the budget. While relevant to concepts of budget instability and planning error, the question of the effect of inflation is beyond the limited scope of this paper and will not be addressed here.

Instability

AND INEFFICIENCY

Miguel A. Otegui

In attempting to define the scope of this inquiry, it is germane to state the importance of focus and vantage point. From the point of view of a program manager in a Service within DOD, exogenous changes to his funding plan are nearly always detrimental, regardless of the reason or the cause for the change. For the Secretary of Defense, at the other end of the spectrum, funding instability ensues from actions of the President and the Congress which could, under given circumstances, be alleviated by readjustment or reallocation among Services or programs.

For our purposes the definition of budget instability assumes that the total funding requested from the Congress under any given budget request represents an optimal level. While this statement may seem naive—one has only to read the newspapers³ to see how proposed budgets do not cover many much-needed programs—it is, nevertheless, logically correct within the frame of reference of the macroeconomic and political “maximum producibility” frontier facing the Executive Branch. The budget of the United States is prepared, as required by the Budget and Accounting Act of 1921, by the President and submitted to the Congress for appropriation in accordance with Article I, Section 9 of the Constitution:

No money shall be drawn from the Treasury, but in Consequence of Appropriations made by Law; and a regular Statement an Account of the Receipts and Expenditures of all Public Money shall be Published from time to time.⁴

The President submits a budget maximizing his political and economic preferences: his constraints are, on the one hand, the need to provide a budget that would further his political agenda and economic policies and, on the other, the need to stay within the ballpark of political preferences of the Congress. The budget is an economic plan, results of which must help “to promote maximum employment, production, and purchasing power,” as prescribed by Public Law 79-304, the Employment Act of 1946.⁵ Within this frame of reference, total economic efficiency—macroeconomic policies promoting maximum employment, production, and purchasing power—is more important than efficiencies narrowly defined within specific sectors of the economy. Economists and systems analysts agree in cautioning against logical inconsistency: under the “fallacy of composition,” an activity or event may be beneficial at the individual level, but harmful at the group or aggregate level. Hence, it is not always clear at what level cost-benefit analysis should be conducted, or at what level are efficiencies realized.⁶

The Executive is assumed to have accepted inefficiencies caused by his decreasing DOD budgets because those inefficiencies are more than offset by their beneficial effect in the total economy; for example, reduction of the deficit, decrease in interest rates, etc. Validity of this assumption should be probed further, but should be the province of separate analysis.

The President’s budget is assumed to be a proposal optimal under economic and political assumptions undergirding it. The political assumption is that the Congress will accept the proposal as being optimal at its proposed level and composition; the economic assumption is that the purchasing power of the dollars budgeted will continue at levels assumed, and that levels of expenditures and revenues forecast by the budget will, in fact, happen. With those assumptions, the inquiry of this paper can concentrate on whether or not the changes made by the appropriation process—budget instability—affect the efficiency of Department of Defense operations.

Is There Budget Instability?

Having defined operationally budget instability, it is necessary to determine procedures to measure it. A few definitions and assumptions become necessary to set the proper framework for the analysis. “Request” and “actual” have been defined; to elaborate, “request” is the estimate forwarded by the Executive to the Congress in the January budget, even if the estimates were amended in March or April. Reasons for this stipulation will become clear later, in discussing the mechanism for translating instability into inefficiency. “Constant year FY 1988 dollars,” indicates that, throughout this paper, the dollar “requests” and “actuals” have been converted, by application of the pertinent deflators, to their equivalent purchasing power in terms of Fiscal Year 1988 dollars.⁷

FIGURE 1. REQUEST-TO-ACTUAL CHANGES

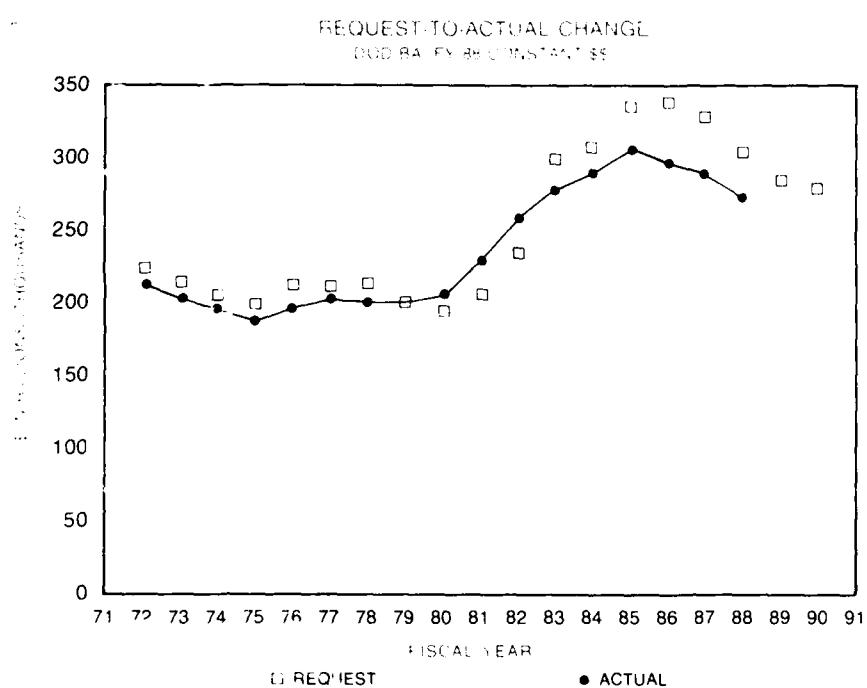
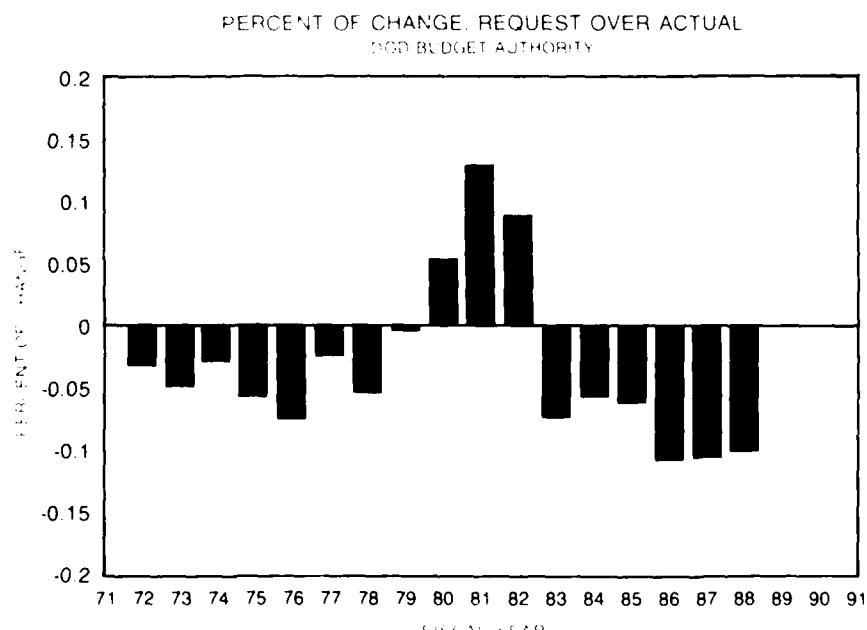


FIGURE 2. PERCENTAGE CHANGE TO DOD BUDGET REQUEST



The paper makes assumptions that congressional action is the cause of any changes between the budget proposed to the Congress (request) and that ultimately executed (actual). This assumption is not, acknowledgedly, always correct: Budget amendments and supplemental appropriations are routinely requested by Defense and other agencies, and reprogrammings occur within statutory DOD budgetary authority, and are included in the "actuals." Since the purpose of the paper is not to pinpoint responsibility for budget instability, but to document its existence, extent, and effects, integrating all such changes into one net change provides, perhaps, the best measurement of instability as it affects the individual program or program manager.

The first task of this paper is to determine the existence and extent of budget instability in the Department of Defense. Figure 1 provides a macro-view of the budget instability problem. The trend line comparison shows that, in varying amounts and rates, total budget for the Department of Defense is changed practically every year. The trend line shows a veritable roller coaster in the amounts funded for the Department of Defense. The difference between request and actual—budget instability as addressed by this paper—is apparent in the trend line in Figure 1, but its magnitude shows more clearly in the bar chart (Figure 2).

Congressional action decreased, on the average, DOD budget requests by 3 percent during this period, even though the largest annual decrease was 10 percent and the largest increase was 13 percent. Figure 3 raises the question of whether the Department of Defense is the appropriate unit of analysis for an inquiry into funding stability in the military, since its component Services differ greatly. Side-by-side comparison of the Services' budgets indicates that, while the general shape of the curve is consistent—corroborating the saying "a rising tide floats all the boats"—the points and direction of inflection of the curve are noticeably different in

FIGURE 3.

BUDGET AUTHORITY TRANSFER AND CHANGES

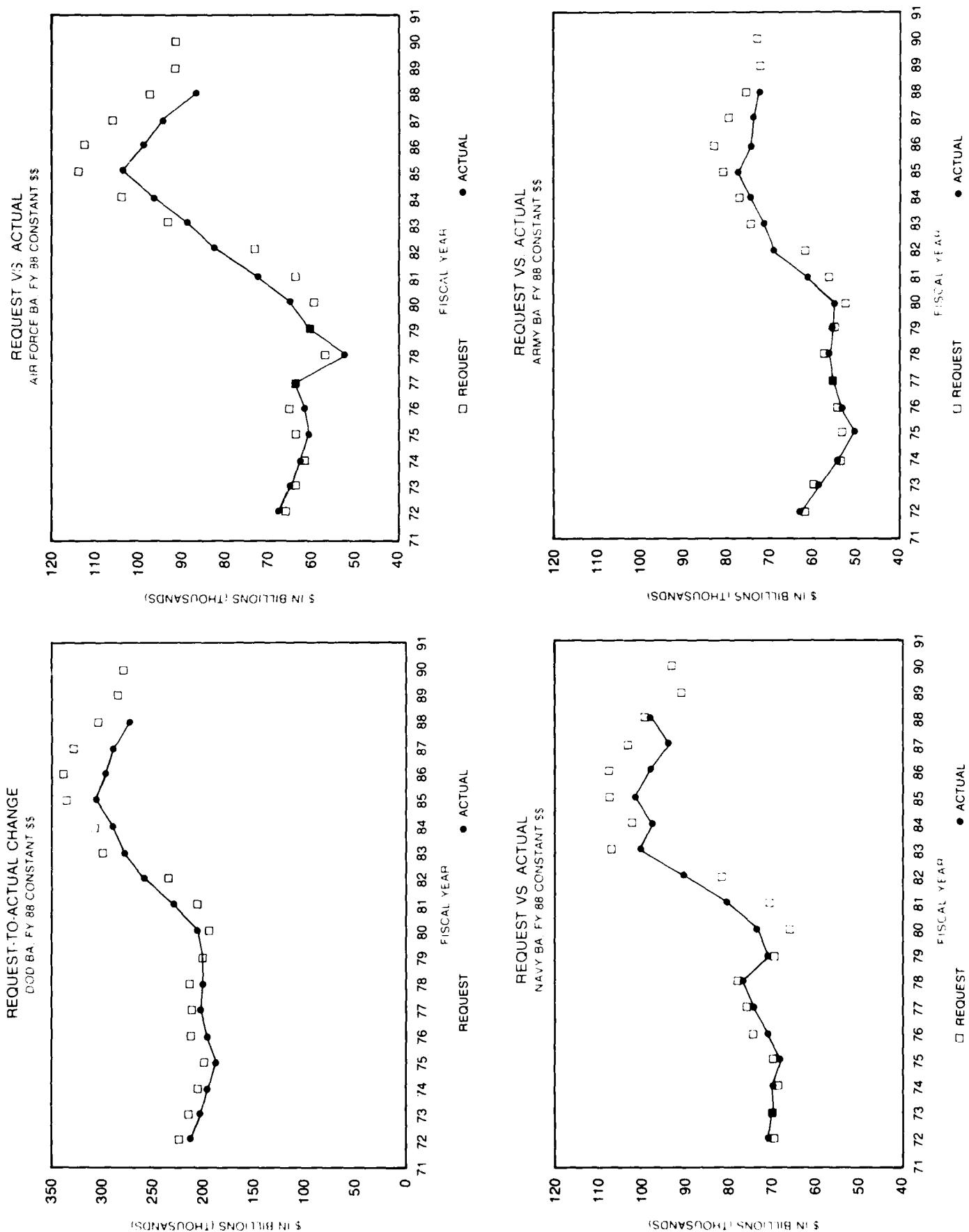


FIGURE 4
BUDGET REQUESTS IN DOLLARS, 1971-1988

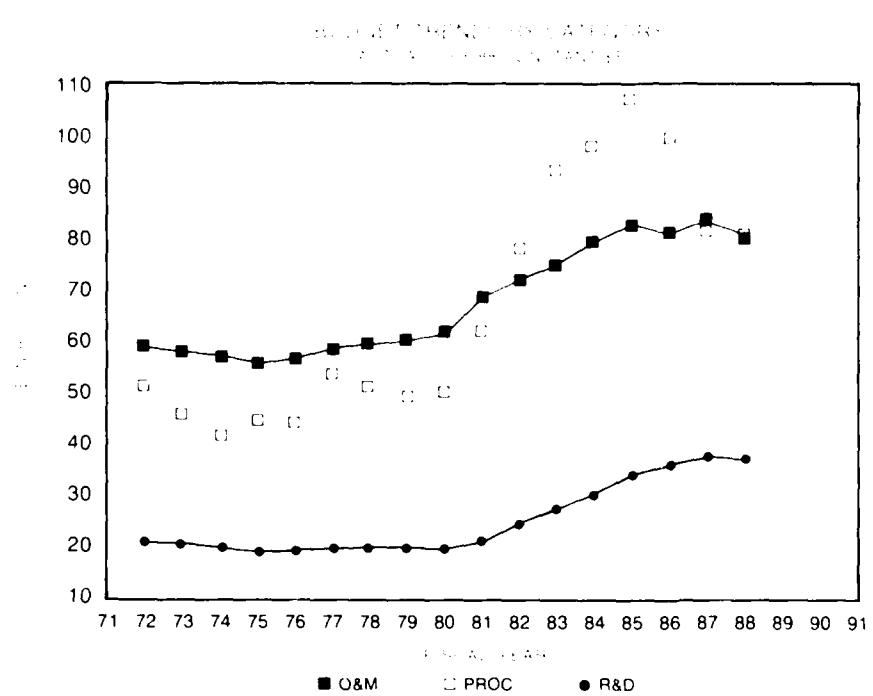
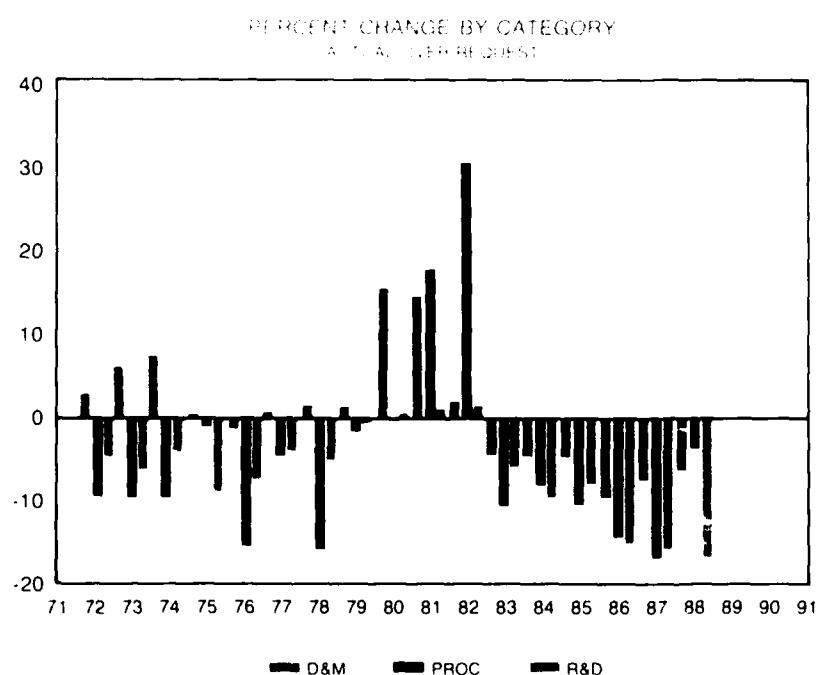


FIGURE 5
PERCENT CHANGE IN REQUEST PERCENT
BY CATEGORIES OF FUNDING



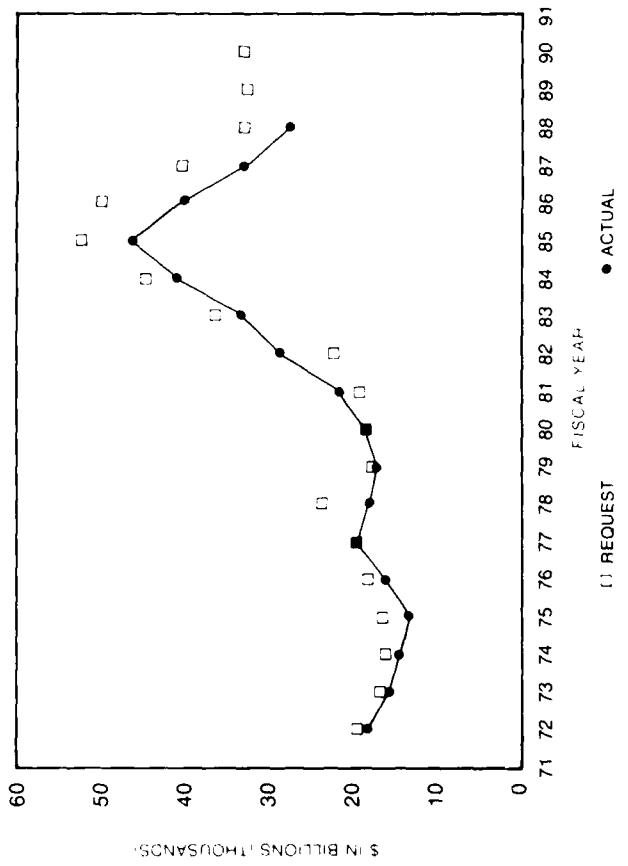
various instances. Figures 4 and 5 introduce a different, more provocative way of assessing budget instability. In Figure 4, three of the largest categories of funding in the Department of Defense were plotted in constant FY-1988 budget dollars: within a fluctuating Department of Defense total, major categories or segments of funding fluctuate more amply, at times in opposite directions.

Figure 5 provides sharper focus on instability of the budget. Setting again the level of the budget request as the zero in the scale, the bar chart plots the percentage change that yearly budget requests experienced during the period for research and development, procurement, and operations and maintenance accounts. The broad swings of the procurement account not only provide empirical evidence of budget instability, but confirm the intuitive expectation that sudden changes in obligatory authority in the Department of Defense are more easily accommodated in the procurement accounts than elsewhere.

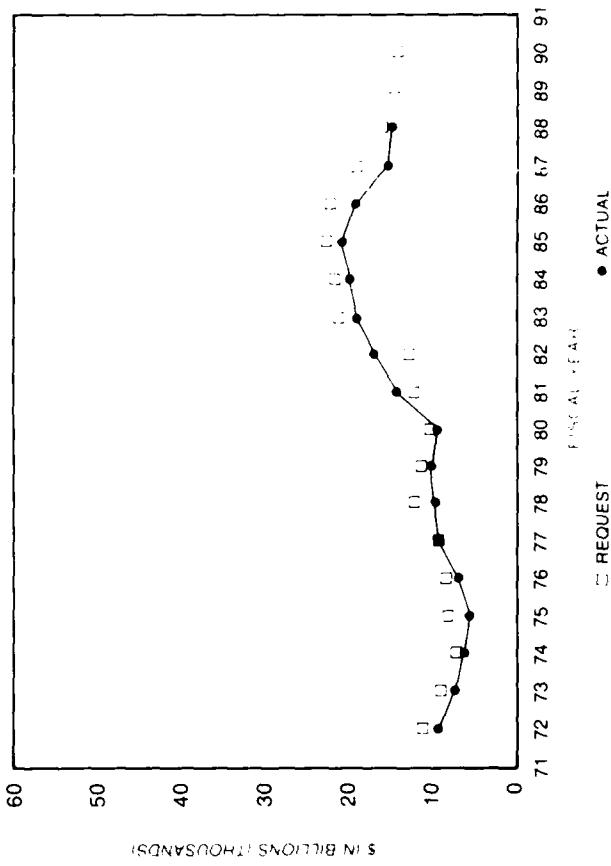
Three more charts, this time at the service and commodity level, provide further insight into distribution and incidence of budget instability. Figures 6, 7, and 8 explore the incidence of budget instability in the procurement area of the Department of Defense budget. Figure 6 plots, in constant-year dollars, budget requests and actuals for the procurement portion of the Department of Defense and the Services budgets; Figure 7 is a bar chart focusing on the percentage change that those requests underwent.⁸ Figure 8 compares the percentage of change in the total budget request for the Department of Defense, with the percentage of change for procurement accounts providing funding for one commodity, aircraft, for the three Services.

U.S. AIR FORCE
CONSTANT DOLLAR
PROCUREMENT

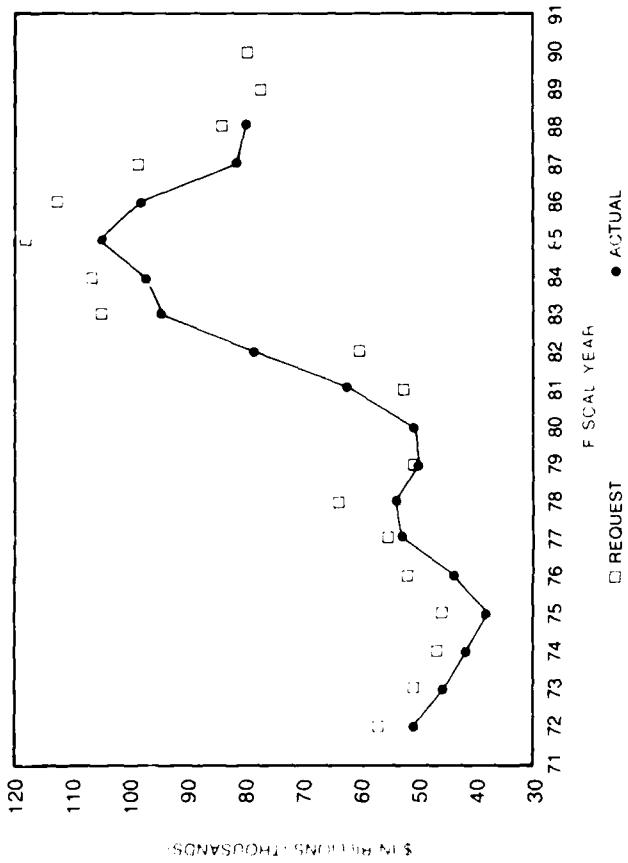
REQUEST VS ACTUAL
AIR FORCE FRCM, FY 88 CONSTANT \$



REQUEST VS ACTUAL
ARMY PROCUREMENT, FY 88 CONSTANT \$



REQUEST TO ACTUAL CHANGE
IN % FOR AIR FORCE FRCM



REQUEST VS ACTUAL
NAVY PROCUREMENT, FY 88 CONSTANT \$

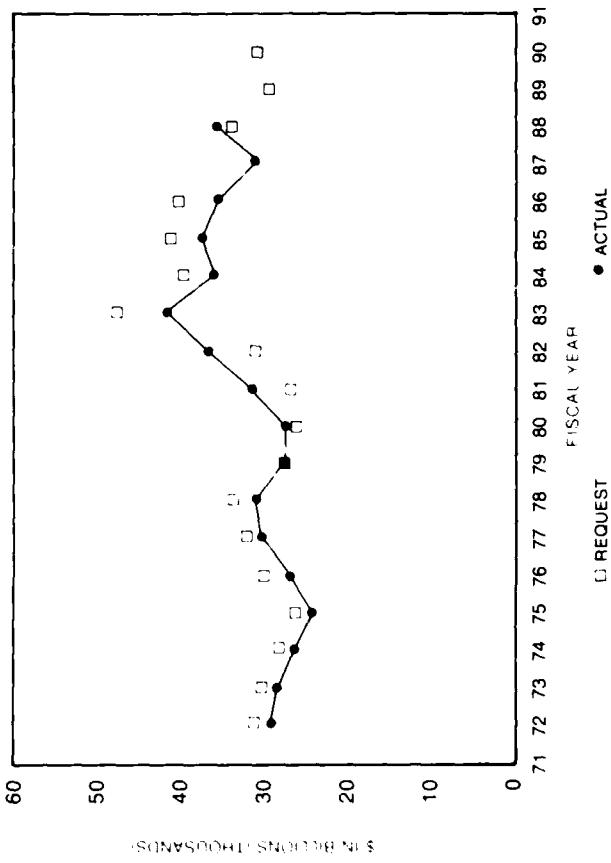


FIGURE 7
PERCENT CHANGE IN ACTUAL OVER REQUEST

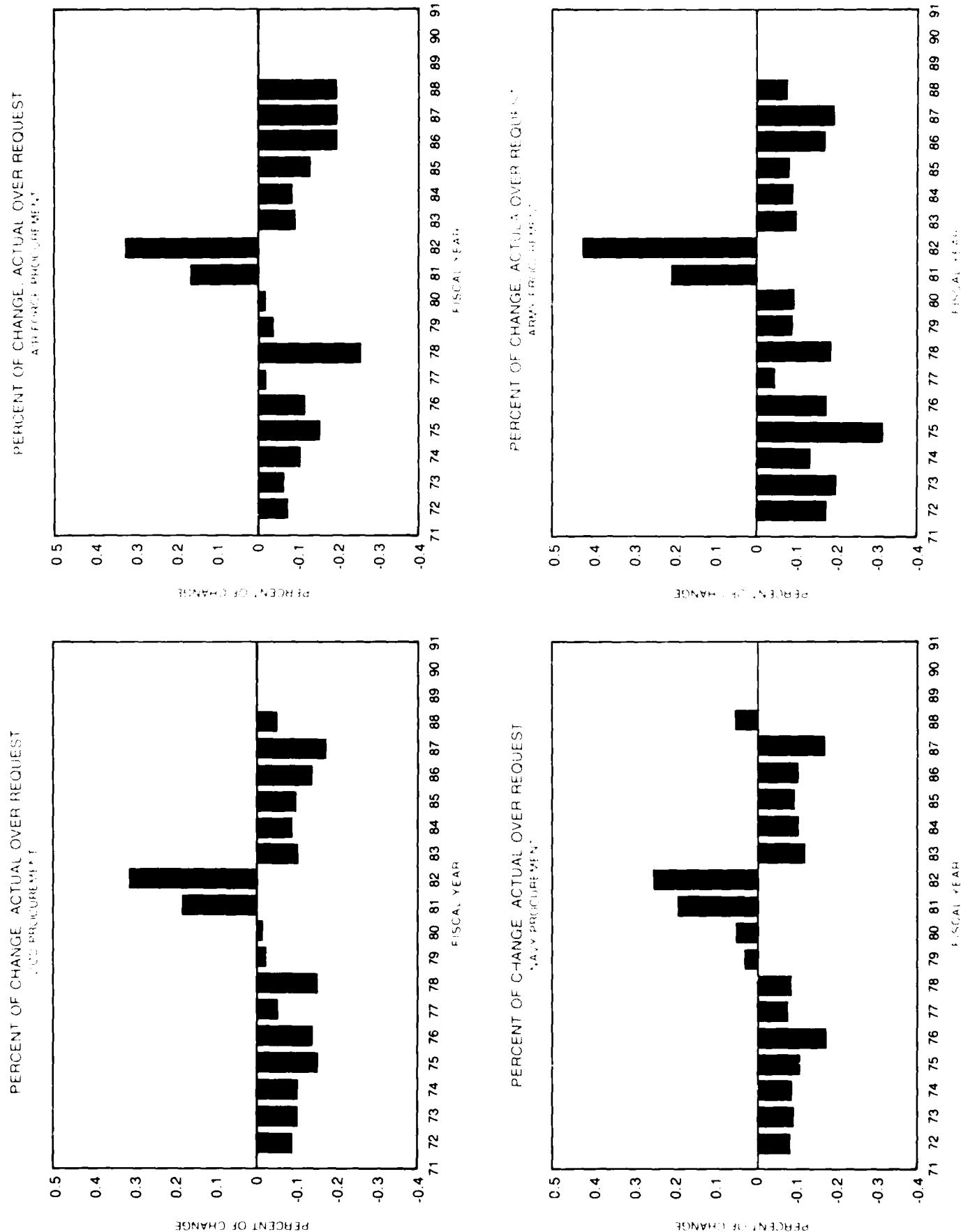
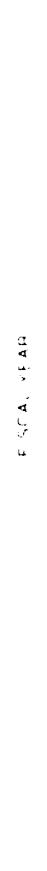
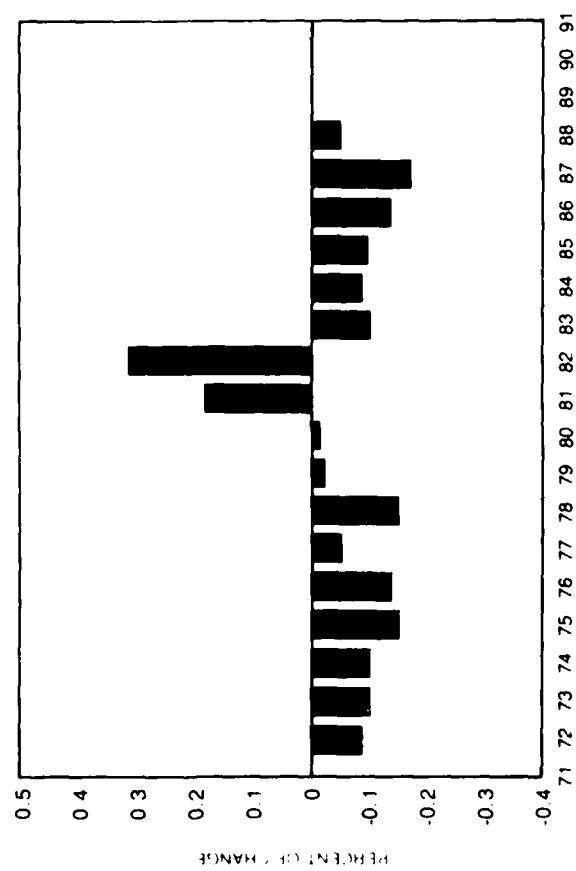
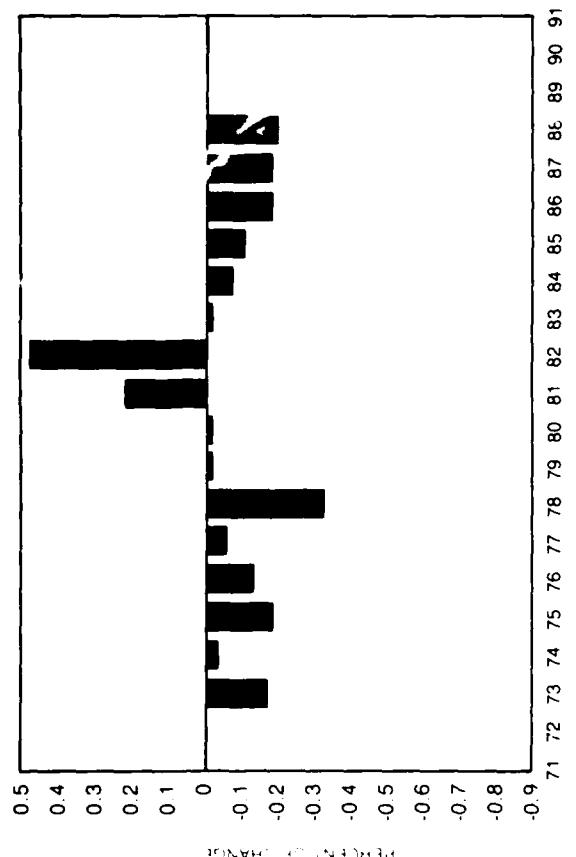


FIGURE 8.
PERCENT CHANGE IN REQUESTS

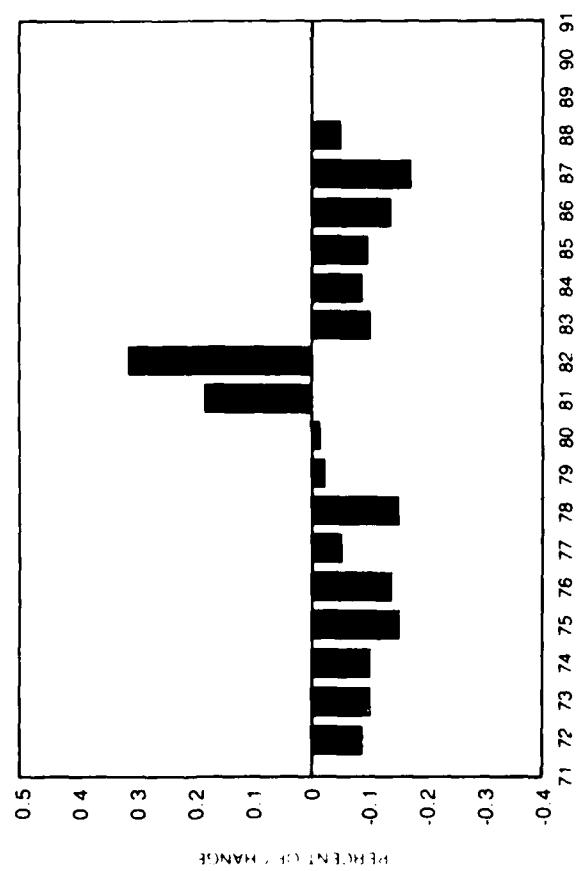
PERCENT OF CHANGE ACTUAL OVER REQUEST
Actual Requests/Actual Requests



PERCENT OF CHANGE ACTUAL OVER REQUEST
Actual Requests/Actual Requests



PERCENT OF CHANGE ACTUAL OVER REQUESTS



Budget instability, in terms of yearly percentage changes to the budget request, increases and decreases, is depicted in all three charts. The charts show that:

—The DOD experienced overall rising budgets for 1972-88, but growth was not steady. Budget instability occurred during rising and declining years; and only rarely did budget actuals approximate their corresponding requests.

—Budget instability is more pronounced in the procurement segment of the DOD budget; and within this category, Services experienced variation regarding percentages and timing of their instability.

—Changes at the appropriation level ranged from an 80 percent decrease in the Army appropriation to a 45 percent increase in Army and Air Force aircraft procurement appropriations. While not coming from a statistically valid sample, rates of change for the three appropriations shown in Figure 8 provide an illuminating view of the extent of budget instability at the appropriation level. The fact that the rate of change differs not only among appropriations dealing with the same commodity across the Services, but between this commodity and the rest of the procurement in the same Service, seems to indicate that severe and widespread funding instability exists in the acquisition of Department of Defense weapons systems.

How Is Budget Instability Inefficient?

From this discussion, it is apparent that budget instability occurs more markedly in the procurement appropriations; hence, its impact—if it exists—will be felt more heavily in the efficiency of the acquisition of weapon systems. Haphazard funding changes in categories such as military personnel or operations are intuitively detri-

mental, in that rigidities of military organization and set levels of required services and maintenance are difficult to change overnight. Budget instability, however, when teamed with long procurement lead-times and current budgetary practices, results in economic inefficiencies in the procurement of weapon systems. The long duration of the production process for items like aircraft and ships, and the budgetary conventions of full funding advance procurement, cause short-notice changes in funding to affect negatively nearly irreversible production processes and actions.

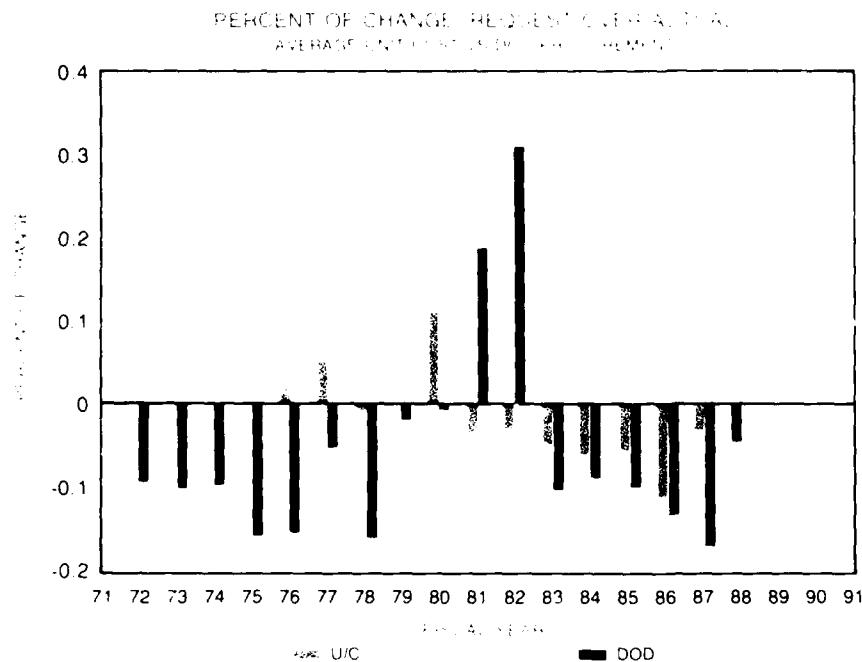
Changes in funding affect projected (budgeted) outputs in three related but separate ways. First, changing the dollars changes the output in an arithmetic fashion; viewed this simplistic way, changes are efficiency-neutral. Reducing the quantity, however, becomes inefficient in a proportion related to economic factors like fixed and variable elements of production; hence, incurring inefficiencies as economies of scale disappear. Increasing the quantity may have one of two antithetical effects; which one results in a given case depends on the circumstances surrounding it. If increased quantities may be accommodated within existing fixed-production factors, unit cost may be decreased increasing efficiency of the process. In a different situation, production of the increased quantity may require increases to the fixed factors of production (plant, tooling, or training more workers). In this case, the result would be increased unit costs in the year the increase takes place. If the increased quantity is maintained in subsequent years, efficiency of the process would be improved in the long run; but if it is later cut back to the previous levels, inefficiencies caused by short-run increases would be compounded by inefficiencies caused by the subsequent decrease.⁹

Related, but independent of these economic factors, is the effect of planning error. Personnel are hired, materials bought, processes started

under the practice of advance procurement and the needs of a production process that stretches over many years. When a sudden reduction occurs, planned activities become excessive or not enough, thus inefficient, for a congressionally changed yearly increment of the program; inefficiencies are compounded by need to adjust back within a short period after appropriation.¹⁰ Strategies for coping may be different, but the problem is basically the same whether funds are reduced by the Appropriations Committees or the quantity of the weapons systems to be procured is reduced by law.¹¹ It is unplanned change, not its source, that affects production and costs.

Inefficient procurement processes should be reflected in increases in the unit cost of the weapon systems affected by the change in funding. Measuring monetary value of inefficiencies is tricky. There are at least five commonly used ways of looking at the cost of DOD weapon systems, resulting in as many versions of their unit cost, and each is impacted differently by changes. Basic building block of the procurement appropriation is the P-1 line for that weapon system. But, dividing total dollars of its yearly budget request into the number of weapon systems procured may give an inaccurate unit cost. The reason is that funding for any given year's weapon system (at least the most complex and costly, the fighter and attack aircraft, the nuclear submarines and the destroyers and tanks) comes from 2 and, in many instances, from 3 or 4 years.¹²

How material this inaccuracy is depends on the use this unit cost will be put to. For a study dealing with total program cost, unit costs derived in this fashion may be acceptable, as differences during the years tend to cancel each other. For a study concentrating on those differences, however, average P-1 cost may be of little use and even misleading, as differences among advance procurement, prior year, and advance procurement, current year may be larger than differences resulting from marginal inefficiencies in production. In the analysis here, weapons system cost has been used.



On the average, how does the unit cost of weapon systems react to budget instability? To provide insight, unit cost behavior of several major weapons systems was obtained, and data correlated with the incidence of budget instability at the total Department of Defense procurement funding level (Figure 9). Unfortunately, and clearly, results are inconclusive. Smallness of the sample used, and heterogeneity of its composition—heterogeneity in this case does not equate to representative randomness—cast doubts regarding their validity.¹³ The study needs to be enlarged and made more systematic before these conclusions can be considered final. In spite of these shortcomings, a provocative, counter-intuitive pattern seems to emerge from the data: decrease-induced instability seems at time to increase inefficiency; increase-induced instability seems to decrease inefficiency. When the procurement budget authority requested by the Department of Defense was decreased in fiscal 1983-87, the average unit cost of the weapon systems acquired also decreased; when the budgetary process increased the budget request in fiscal 1981-82, average unit cost decreased comparatively little.

Difficulties of accurately measuring the impact of budget instability on the procurement programs do not end with those tentative findings. The budget request total in 1990 was \$3012.1 million for the 150 F-16 aircraft. This amount was intended to cover more than the cost of the aircraft as they rolled out of the production line and were accepted by the government. The budget request for that fiscal year included funding for non-recurring engineering and support, neither of which is related to the airplane production of that fiscal year. Typically, non-recurring flyaway engineering will support airplanes of the future; support will fund airplanes procured in the past. There are variations and nuances in the types of support, and in its purposes, all related to the aircraft but not necessarily that-year aircraft. The point to be made is that funding requested in the non-recurring and support accounts is not a function of the number of weapon systems procured: budgetary guidance requires requirements for the aircraft to be fully funded, while requirements for support and non-recurring are

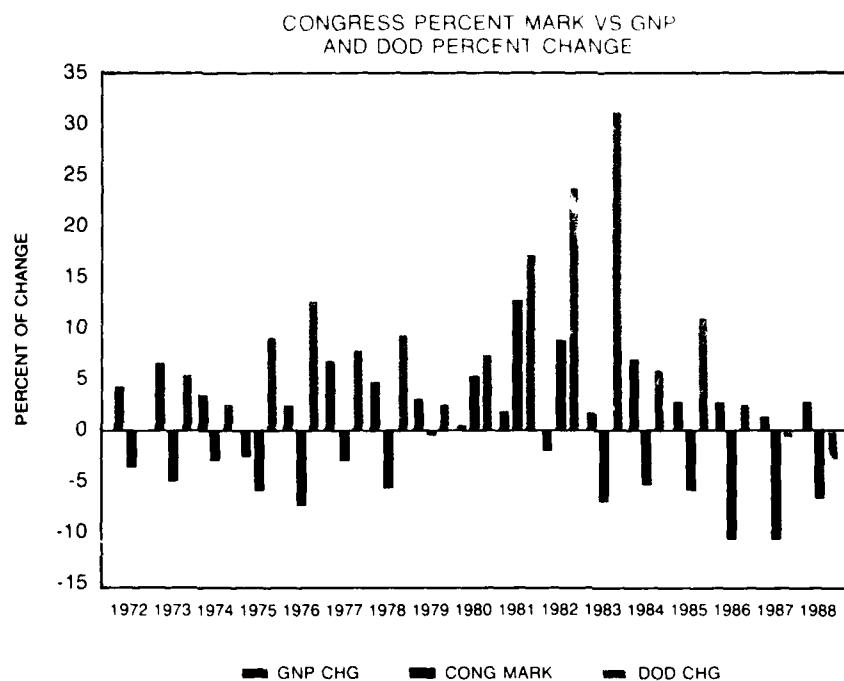
annualized. Hence, even the weapon system unit cost used in this analysis is a poor proxy for the flyaway/sail-away/rollaway unit cost that, according to the hypothesis—and widespread consensus—should fluctuate in response to economic factors of marginal efficiency of production. As mentioned, more study is required to provide empirical evidence of instability-generated inefficiencies in procurement.

Further and more rigorous analysis of the effect of budget instability on the cost per unit of our weapons systems is being pursued by staff researchers of the Defense Systems Management College. Results of this research will be published soon.

Economics, Politics, and Instability

Attempts to correlate budget instability to economic and budgetary indicators failed to show significant correlation. Changes to the budget during the appropriation process do not seem to respond to increases or decreases in the requests for total DOD budget or the DOD procurement budget. Neither does correlation appear in comparing change in the budget request with change in macroeconomic indicators such as the gross national product or the size of the deficit. Figure 10 depicts results of one attempt at correlation.

What then prompts the Congress to change budgets and programs around, if neither changes in the budget nor the economy seem related to them? A hypothesis not contradicted by the evidence would hold that the Congress does react to macroeconomic or budgetary imperatives, but only when those imperatives are translated into public opinion and constituency-concern issues. Logically, budget instability as defined in this paper can be prevented by a political understanding whereby the DOD procurement budget presented by the President is considered optimal by the Congress and appropriated as presented. "Unfortunately, the prerequisites for this strategy, including political consensus on what constitutes sufficient military expenditures, do not exist."¹⁴ Approval of the request *in toto* appears contrary to the essence of our political soul, the separation of powers. Fragmentation of power among congressional committees indicates the near impossibility of achieving unanimity, which many would call subservience to the President. Obviously, minimal changes would have minimal impacts; but, as hypothesized, changes to the plan would bring inefficiencies of scale or planning errors, even if minimal. Another way of preventing instability in the procurement account would be for the Congress to make changes without prejudice: The Department of



Defense or President could reprogram funding among accounts if changes were demonstrably inefficient and costly.

It has been assumed the procurement budget as presented to the Congress was optimal; but, from the perspective of the Congress the procurement budget may not be optimal, either in total amount, composition, or relationship to the civilian sector of the budget. After all, the Congress has the undisputed power "to raise and support Armies...[and] to provide and maintain a Navy."¹⁵ Realistically, the Congress will normally continue to evaluate estimates and make changes according to its priorities. In the same vein, the likelihood of more extensive (over the already existing) reprogramming authority is small. After the Nixon impoundment battles, and the continuing argument regarding line-item veto, the prospects are not encouraging.

Conclusions

That budget instability related to the budget appropriation process exists seems supported by the evidence; that this instability is translated into inefficiencies of production that result in

higher costs is widely believed, but not clearly supported by evidence gathered so far. If budget instability is to be prevented, it has to be clearly shown as being wasteful:¹⁶ The Congress and the public have to see it in that light. Only a ground swell of public opinion—similar in intensity but longer lasting than the Reagan "mandate"—would provide for the momentous congressional change of mind required.¹⁷ Acceptance of what could be considered an indexing of DOD funding to the yearly 2 percent steady real growth that the Department of Defense long-range forecasts have built into the FY 1990-94 estimates¹⁸ would require wide-based congressional and public support.¹⁹

It is important that the negative impact of budget instability be quantifiably identified: A clear and convincing exposition of associated inefficiencies should generate some support to alleviate, if not preclude, its negative impact.

This paper provides the budget background at the aggregate level. I hope that further, and in-progress research will provide additional empirical evidence at the weapon-system level.

Endnotes

1. *Annual Report to the Congress, Fiscal Year 1990, Executive Summary*, p. 22.

2. In order to keep the meaning as precise as possible, I will call "request" the amount of the estimate submitted initially, and formally, in the *Budget of the United States Government* book. "Actuals" are the amounts shown for a given year in the "actual" column of the *Budget of the United States* 2 years after initial submission.

3. For example, see "Revised Budget Makes Deep Cuts in Defense Fabric," *Defense News*, Vol. 4, No. 18, 1 May 1989, p. 36.

4. "Constitution of the United States (1789)," *Basic Documents of American Public Administration, 1776 to 1950*, Frederick C. Mosher, ed. (New York: Holmes & Meier Publishers, Inc. 1983) p. 18.

5. "Employment Act of 1946," *Basic Documents of American Public Administration, 1776 to 1950*, Frederick C. Mosher, ed. (New York: Holmes & Meier Publishers, Inc., 1983) p. 178.

6. For a discussion of economic examples of fallacy of composition see, for instance, Campbell R. McConnell *Economics: Principles, Problems, and Policies* (New York: McGraw-Hill Inc., 1981) pp. 16, 200, 201. For a systems view of the same problem, see C. West Churchman *The Systems Approach* (New York: McGraw-Hill Inc., 1979) pp. 49-61.

7. Constant-year dollars throughout this paper are FY 1988 constant dollars; that is, dollars made comparable in purchasing power by application of the deflators provided by the pertinent tables of the *National Defense Budget Estimates for FY 1988/1989*, Office of the Assistant Secretary of Defense (Comptroller) May 1987, pp. 49-57. The same deflator rate has been applied to the "Request" and "Actual" portions even though, as explained, applying a "projected" and "actual" rate of escalation to the "Request" and "Actual" versions of the budget would have given a more complete picture of budget instability.

8. The difference between the actual budget and the budget request divided by the budget request, as percentage change of the budget request.

9. For other elements of procurement cost dynamics see Franklin C. Spinney, *Defense Facts of Life: The Plans/Reality/ Mismatch* (Boulder: Westview Press, 1985) pp. 130-136.

10. For a discussion of how difficult it is actually to determine the "best" production rate, or to ascertain differences between estimates at different rates of production, see Gordon Adams, *Controlling Weapons Costs: Can the Pentagon Reforms Work?* Council on Economic Priorities Publication, pp. 24-25.

11. 10 US Code 138 establishes types of weapons and activities requiring quantity authorization before appropriation of funds and execution of programs.

12. See P-1 line items 6 and 7 of the Aircraft Procurement Air Force Appropriation for a helpful example of the mechanics of procurement budgeting.

13. The sample included 7 Navy aircraft, 4 Air Force aircraft, 1 Army aircraft, 2 ships, 2 combat vehicles, and 5 missiles. Observations, constrained by availability of data, numbered 150 for 1976-86. Observations concentrate heavily on 1982-88.

14. Aaron Wildavsky, *The New Politics of the Budgetary Process* (Glenview, Ill.: Scott, Foresman and Company, 1988) p. 379.

15. Article I, Section 8, Constitution of the United States.

16. Budget instability as a defined, quantified cause of cost growth has not found its way into official budget/program documents. The Selected Acquisition Reports (SAR) do not show budget instability as one of the causes of cost growth. See, for example, GAO/NSIAD-89-32FS *WEAPONS COST: Analysis of Major Weapon Systems Cost and Quantity Changes*, November 1988, Appendix I, p. 12 for a listing of definitions/categories for changes in program costs.

17. In concept, if not in detail, granting the Executive the power to determine the proper level of funding for the DOD would not be much different from the transfer of control over the power to coin money that the Federal Reserve Act of 1913 granted to the Federal Reserve System, or the power to pay debts and borrow money that went to the Treasury Department under the Liberty Bond Act of 1917. However, see Howard E. Shuman, *Politics and the Budget: The Struggle between the President and the Congress* (Englewood Cliffs, New Jersey: Prentice Hall, 1988) p. 18, to appreciate the crisis atmosphere that prompted those laws.

18. Annual Report, FY 1990, p. 23.

19. For a description of political difficulties to be overcome to index a program for inflation, see R. Kent Weaver, *Automatic Government: the Politics of Indexation* (Washington, D.C.: The Brookings Institution, 1988) pp. 211-228.

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NEEDED CHANGES IN WEAPONS TESTING

Dr. Jacques S. Gansler

The last few years have seen a dramatic shift in the perception of the purpose of test and evaluation (T&E) in the development of America's weapons systems. This change of emphasis has had extremely adverse effects in schedule, cost, and performance. It is time to return the focus of T&E from an "auditing" function to the original objective of contributing to the timely delivery of high-quality, cost-effective weapon systems.

This need for change comes from two overriding Department of Defense budget problems. First, the Department of Defense (DOD) is faced with a \$400 billion annual planned program and a \$300 billion annual budget. With a projected "level" (at best) future defense budget and individual weapon costs continuing to grow (from a B-1B costing more than \$200 million each to a B-2 costing more than \$500 million each), the problem is going to get worse.

Second, there is a whole new generation of weapon systems that must be developed and deployed to keep America's technological edge; these range from ceramic tanks, through plastic airplanes, to zero-miss-distance, long-range missiles and space-based defense systems, all very expensive, yet needed. Clearly, the budgetary crisis is going to force DOD to do things differently.

These overall DOD problems are mirrored directly into the T&E world. It is generally recognized that our T&E resources are inadequate. We haven't been making needed investments for adequately testing weapons now in development and nearing deployment (from space-based systems through submunitions). Nor has the United States made investments required to realistically simulate the full threat environment, especially of enemy forces rather than individual weapons. Finally, the nation has not made investments required to provide adequate numbers of weapons for tests to demonstrate boundaries of weapons' capabilities. In fact, the rising unit costs of advanced weapons have resulted in the perverse situation that the more complex (and expensive) a new system is, the less we can afford to test it and, therefore, to explore its problems and operational utility.

Next Generation

Unfortunately, like the overall DOD budget, T&E resources are likely to be further strained by the next generation of weapon systems under development. These new systems will require higher accuracy, smaller size, longer range, etc., characteristics that will demand additional funds to adequately test and evaluate them. Yet, these funds are not likely to be made available! Thus, the United States is going to have to do something different in the T&E area.

To begin this required change, it is essential we reestablish the real purpose of testing. In recent years, T&E has become a product unto itself. Rather, it must return to its original purpose of being a critical contributor to the overall acquisition process of new weapon systems—an aid in the development of top-quality and affordable military equipment. The Congress, the Government Accounting Office, the media and others have been stressing, almost to exclusion, the quantity of testing done immediately before production of a weapon, and the independence of those performing the weapons' tests. Notice that this emphasis is effectively on the auditing role of testing, rather than its developmental contribution. Instead, the emphasis in the T&E area must be balanced to ensure there is sufficient focus on the quality of testing, in finding problems that need correcting and the early timing of testing. The overall intent should be that of testing as a necessary and vital element within the development process, and the "earlier the better."

Four specific actions would aid in the needed redirection of weapons test and evaluation. First, there must be recognition that the required new direction in product development, in civilian and military sectors, is toward an integrated process; one that links engineering, manufacturing and support. The so-called concurrent engineering initiative within the Department of Defense is clear evidence of this DOD shift. The Japanese have been using such an integrated process for some time, and U.S. "world class" suppliers have been

rapidly shifting in this direction. No more can DOD afford to have independent stove pipes in each specialty, and this must apply equally well to T&E. The development process is inherently full of surprises, and T&E must be part of the team finding them and correcting them, in the early phases of a product's development. The T&E must not be viewed as a "pass/fail final exam!" The current congressional concept of some independent testers standing off and watching the development process for 8 years, and then seeing if the new product "works" before putting it into production, is the wrong concept and unaffordable.

Additionally, it is critically important that everyone recognize that it is only when a system fails under a test that anything new is actually learned. A development process is intended to have failures. It is the only way we will be able to develop a product that will be continuously improved and later will be able to do its military job when deployed in the field under extreme and stressful conditions. If failed tests are recognized as "successes," because of what we learn from them in order to improve the product, greater honesty can be introduced into the T&E process. Surely no one, least of all military personnel who will have to use the system in wartime, want to deploy a weapon that doesn't work. Thus, the concern must be with assuring that sufficient failures occur during testing to determine where weak spots in the

system are, and that these are subsequently corrected and the system continuously improved. In this way, T&E becomes part of the development team, serving developer and user. While we have been stressing independence of testing, the true purpose of contributing to the design and development of the weapon system itself has been pushed aside.

Emphasis and Purpose

The second needed change is a shift in emphasis and purpose of weapons prototyping. No longer can the nation afford to use prototypes solely for answering technical feasibility questions. The proposed weapons must be demonstrated to be affordable in the quantities required, and to be opera-

tionally useful. Thus, we must do much more testing, including operational, with prototypes; and these tests must realistically simulate advanced enemy threats likely to be seen during the time of weapons deployment (rather than simply showing that our advanced system works against their current system). Testing prototypes, before commitment to full-scale development and production, is an extremely cost-effective time for testing. If adequate testing is done before detailed design of the system, the quality, usefulness, and robustness can be designed into the weapon system. This is far more inexpensive than testing it into the system later on, and redesigning the system or scrapping it. Notice that in this concept of prototype test and evaluation, the role of the T&E community is less one of veto power than one of helping in the early performance-versus-cost trade-offs. The T&E personnel, developmental and operational testing people, will help determine which aspects of the design are necessary and which are nice-to-have, with the latter being amenable to affordability trade-offs.

The third needed change in the T&E world is in direct response to the high cost of sophisticated weapon systems and the high cost of test range instrumentation for these advanced systems. As an alternative, the T&E world must learn to make greater use of advanced computing technology. This is an extremely cost-effective direction in which to move. The state-

of-the-art of advanced computers, including parallel processors and advanced display systems, offers enormous potential to the T&E world; for example, in pre-test encounter prediction, hardware in the loop simulations, evaluation of software-intensive weapons systems, and computer-based expert systems for test data analysis. Because of the high cost of live testing for many advanced weapon systems, the limited testing must essentially be used to verify computer models. That clearly means the models have to be better and more inclusive than they are today. This will require spending added research and development money in this area and will have to be done outside normal weapon system budgets, since an individual weapon system will not be willing to develop generic, computer-based simulations. Separate line-items should, therefore, be established (something initiated within the past year) and adequate budgets set aside for these extremely cost-effective efforts.

Quality and Experience

Finally, the fourth necessary shift, and the one absolutely required to make any improvements in T&E effective, is a greater emphasis on the quality and experience of people in the T&E area. Experienced and trained people, government and industry, are required to match sophistication of the new weapon systems and of the advanced T&E instrumentation equipment. We cannot test smart weapons with either government or contractor people purchased at the lowest hourly rate. It's a gross mismatch! We need technically qualified professionals and we must recognize we will have to pay for them. It's the only way to get the best value for government money. A few dollars invested in higher quality, more experienced people can save millions or billions of dollars in the effectiveness of the T&E work performed on the advanced weapon systems. When we buy T&E engineering support services at \$7.29 an hour (which the DOD did on one occasion last year), we get exactly what we pay for. You don't get creativity or quality professionals by buying them "cheap." When we look for a defense lawyer, a

tax accountant, or a heart surgeon, we don't look for the lowest hourly rate because we recognize the impact that their quality can have on the results. Why should we not apply similar logic to the critical job of testing and evaluating our billions of dollars worth of advanced weapon systems?

In the defense weapons acquisition business, we must eliminate the procurement concept of "technically-acceptable, low-bid wins." A world class company wouldn't use it; the Japanese wouldn't use it; and the DOD can no longer afford it. "Continuous product improvement" at continuously lower life-cycle cost is clearly the wave of the future, and America's weapons acquisition process must get with it.

In conclusion, four significant changes can have a dramatic impact on growing T&E and weapons acquisition resource problems. Specifically in the T&E area, we must:

—Assure that T&E is fully integrated into the acquisition process

—Perform operational testing on prototypes, particularly as an aid in the cost-performance trade-offs required

—Make far greater use of advanced computing technology in the T&E world

—Significantly increase emphasis on quality, versus low cost, in the people involved in T&E, both on the government and industry sides.

Refocusing

To achieve these changes and get maximum effect will require refocusing on the proper definition of test and evaluation from a product of its own (a pass/fail final exam), to an essential element of the acquisition process. This involvement must go from the front-end of a weapon development through post-production product upgrades. In each phase, it is quality of the testing and the early timing of testing that must receive greater emphasis. It is not that the quantity and independence of testing is irrelevant but, rather, that there must be a far greater balance to the current overemphasis on the auditing function of testing.

The coming years are going to be extremely difficult for the Department of Defense from fiscal and technical points of view. Creativity and ability to make changes will be critical. The T&E world can either be an obstacle to these required changes or a critical part in their achievement. For the latter to happen, a refocusing of the objectives and emphasis in the T&E area is clearly required and must be initiated now.

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WHAT PROCESSES DO YOU OWN? HOW ARE THEY DOING?

Robert D. Aaron

During the 1800s, Adam Smith and Charles Babbage represented the highest level of knowledge in industrial management from which the concept of division of labor was popularly employed in production organizations. During the early 1900s, Frederick W. Taylor, Frank B. and Lillian Gilbreth, and Henry L. Gantt significantly added to the existing knowledge on management of manufacturing organizations.

Time study, job design, personnel selection and training were among the areas to which Taylor made major contributions.

The Gilbreths contributed results from studies in motion and developed effective research techniques for motion study.

Gantt is well known for the Gantt Chart, still a commonly used production control device for loading and scheduling work on machines.

Where are we now? As we approach the 21st century, two noteworthy American names often are referenced. Tom Peters and Dr. W. Edwards Deming. Peters is the author and co-author of best selling management books, his latest entitled "Thriving on Chaos - Handbook for a Management Revolution." Revolution is a key word.

Dr. Deming is most popular for his contribution to Japanese industrial success and recently has found a receiving ear from the Department of Defense. Dr. Deming often is referred to as "The Father of the Third Wave of the Industrial Revolution." Again, we hear the word "revolution."

Popularity of the last two authors is due to the need of new management approaches as markets become more diversified, more competitive and global; products and services of those products become more complex; and customers become more demanding. Peters and Deming respond with specific methodologies, tools and concepts that any producer of goods or services can use to satisfy customers, improve response of their organizations, and reduce costs.

It must be recognized that with each new century new management approaches were necessary for the advancement of successful organizations whether they be producers, providers of services, or both.

One foremost authority on these contemporary concepts, Bill Conway, described them as a paradigm shift in thinking. As an example of a paradigm shift in thinking, Mr. Conway uses this example: "When Columbus discovered that the world was round, not flat as most people believed, a paradigm shift in thinking was required."

It is important to note that these management paradigms are not necessarily new, merely recognized as commonly employed in the more successful organizations. Exactly what these management paradigms for the next century are is the subject of this paper.

Department of Defense

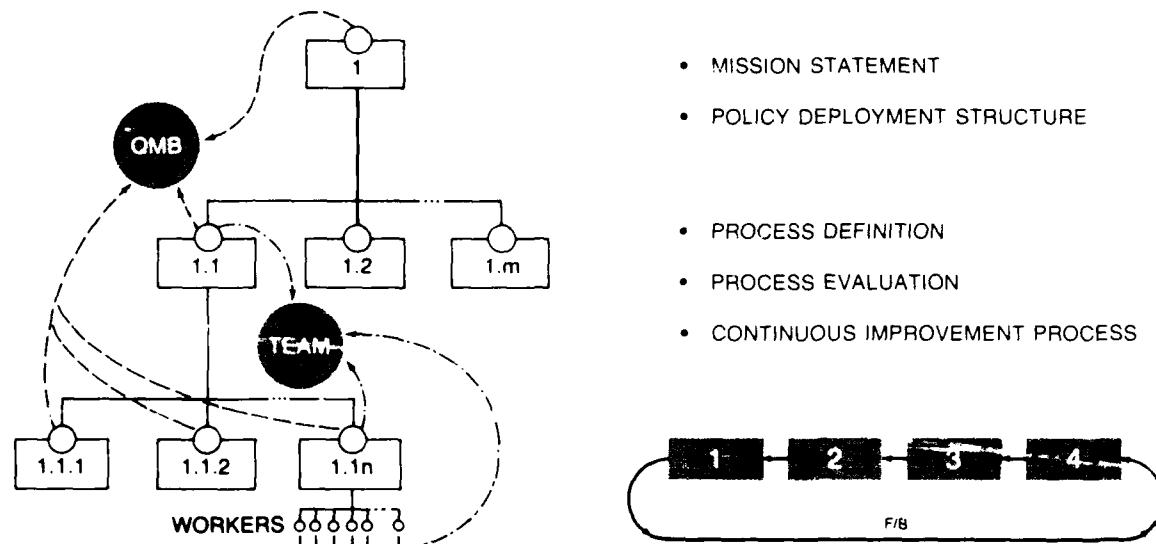
In the Department of Defense, we call these new concepts *Total Quality Management* (TQM), a management process aimed at continuously improving processes. It involves everything DOD does, produces or procures. Total Quality Management combines contemporary recognitions in behavior sciences, fundamental management principles, and a theme for quality and customer focus. The concept that quality is profitable and leads to increased productivity is an underlining principle supported by many case studies. The following 10 TQM principles are presented as a brief outline of an expanded definition of TQM:

1. Constancy of Purpose and Mission
2. Commitment to Quality
3. Customer Focus
4. Process Orientation
5. Continuous Improvement
6. Systems Centered Management

Management Creates the Environment by:

7. Investment in Knowledge
8. Teamwork
9. Structure the Organization
10. Total Involvement/Participation (Empowering Employees with Ownership).

While some of the concepts are easily understood, others are difficult to perceive immediately. Five most important and difficult (to understand) elements of the expanded definition have been selected to be the subject of this paper for the purpose of conveying the paradigm shift in thinking and connecting these concepts in a unified thought. They are:



- Mission Statement
- Policy Deployment Structure
- Process Definition
- Process Evaluation
- Continuous Process Improvement.

As you read through this explanation, recognize how goals and mission of the organization are represented by processes of the organization. You will recognize interdependency between elements of the TQM definition.

Mission Statement. Top management is responsible for articulating the mission statement, for directing activities to fulfill the mission statement, and for continuous modeling of TQM behavior in everything they do. The mission statement conveys objectives of the organization as developed from *raison d'être*, constancy of purpose. The mission statement will include things like the overall mission of the organization, the desire for exceptional quality of products or services, and the level of customer satisfaction to be pursued. Levels of quality must be defined. For example, there is exceptional quality, expected quality and poor quality. Exceptional quality is the product trait that gets customers so excited about the product or service that they constantly brag about the product or service. The underpinning concept is exceptional quality maintains present customers and develops new customers. An incessant relationship between the organization and the customer promotes clearer understand-

ing of customer needs and facilitates greater customer satisfaction and/or development of new markets. This message must be constantly reaffirmed in everything we do. As an example of constant reaffirmation of the quality theme of an organization, consider repetition of the mission statement during meetings. Mission statements may be as short as a few sentences, never more than a page or two.

Lower level organizational components develop their own mission statements that support the top-level mission statement through the policy deployment structure.

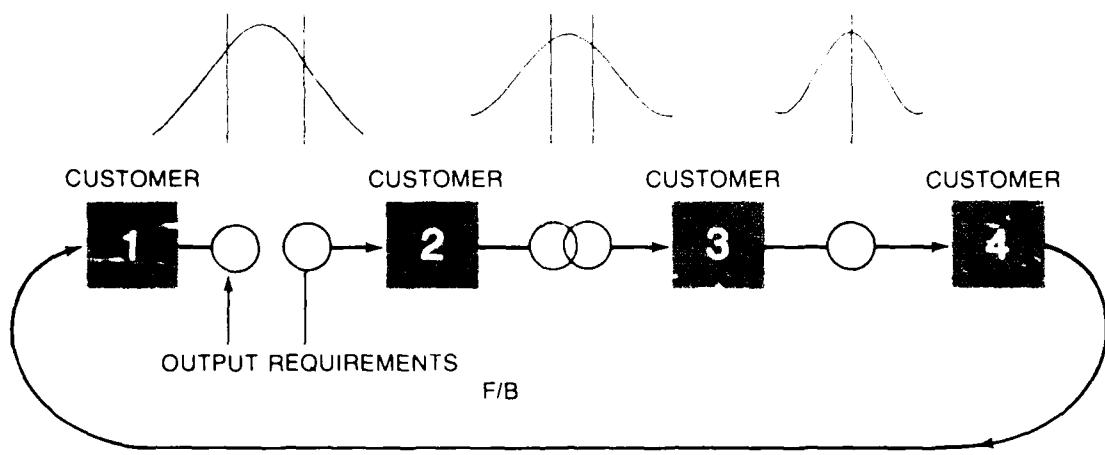
Policy Deployment Structure. The policy deployment structure is the organizational structure that conveys the mission statement (exceptional quality goals, and the objective of customer satisfaction) throughout the organization. The structure begins with the top-management team which establishes quality management boards, and process action teams (sometimes called process improvement teams or many other names). Whatever the name, there is a link-pin arrangement from top management to the lowest level in the organization. This is structured by team leaders of lower-level teams as members of higher-level teams. Members of this structure are selected directly from product/process teams, thus avoiding a separate policy organization. This structure improves policy development

due to the direct involvement of the member in product process and policy development. Long-term relationships built into these teams foster trust, faith, and support among members and between teams. Another significant benefit of teaming is that any member can and may be a leader. This is especially useful when a team leader's energies wane. Individuals and teams as a whole have a good feeling knowing where they fit in the overall structure, process, and mission of the organization (see Figure 1, left side).

The Quality Management Board (QMB) or Executive Steering Group (ESG) membership is permanent and includes high-level members of the organization. It is responsible for the organization's quality, develops quality measurements for achieving customer satisfaction, and promotes strategic plans for improving quality of present and future products and processes.

The Process Action Team (PAT) develops its process for achieving its goals and maintaining a continuous improvement process (CIP). It must develop the critical and quality measurements for the processes it owns. It is usually permanent, and the team may own one or more processes. There may be several PATs in an organization.

The mission statement is deployed through these teams and boards, from high levels of the organization through



—VOICE OF THE CUSTOMER = VOICE OF THE PROCESS
 —DETERMINISTIC VS PROBABILISTIC

the lowest level organizational teams which own processes. It is imperative that each and every team and board recognize its counterpart teams as customers and satisfy them as well. This concept is often referred to as knowing the organization's internal customers as well as the external customers. The mission statement for the organization must be clearly understood at all levels in the organization from highest to lowest levels, for the organization to respond to this concept.

There may be cross-functional teams, as well as specialized teams. Membership on these teams is temporary or permanent and functions are cross-functional or special as required on unique projects.

Process Orientation

A process orientation includes process definition, process evaluation, and continuous process improvement. At one time, manufacturing organizations recognized the usefulness of documenting each step of an operation and labeling the aggregate a process. The paradigm here is for management to recognize that systems and organizations are so complex and diversified, it is necessary for management to utilize a documented process approach and new process evaluation tools for gaining optimal effectiveness and efficiencies. The following discussion is to help management recognize that it must document the processes it is

responsible for (whether it be one or several) and that if you can't measure it, it must not have any usefulness (value). (See the bottom right of Figure 1.)

Process Definition. As indicated above, every team owns one or more processes. Within an organization, the customer is the next process. The goal here is for the team to achieve the Voice of the Customer equal to Voice of the Process. This goal is also presented as the system approach of reduction of variability between output of one process and the requirement of the next process. This reduction of variability is improved upon to achieve customer satisfaction. In Figure 2, only in the final steps (between steps 3 and 4) of the process do outputs equal requirements.

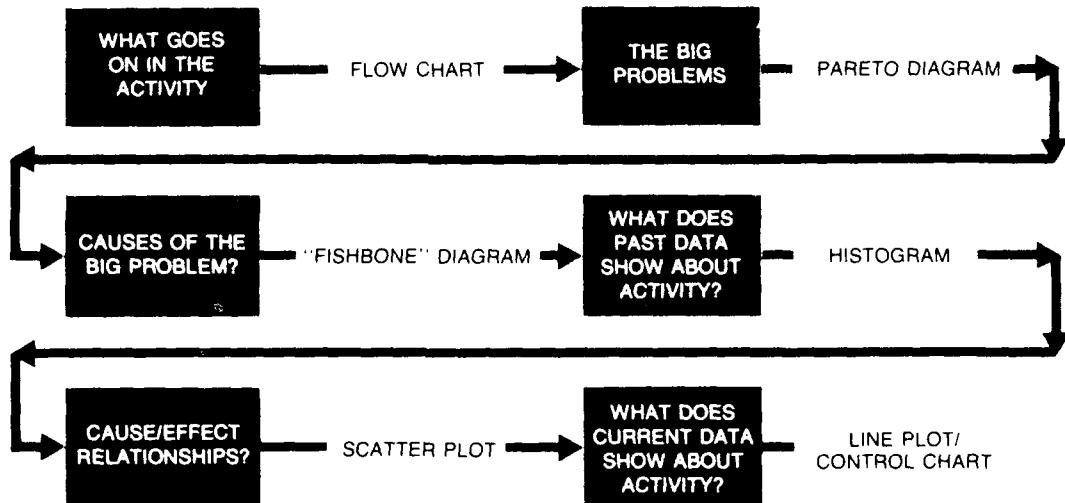
As an example of the difficulty of process definition, the following example was provided by Bill Sherkenback, the TQM consultant who was principally responsible for implementation of TQM at Ford Motor Co., and is now working with General Motors. He points to a figure that has more than 120 steps on it and states that the company which owned this process took 6 months merely to define it. This difficulty of identifying and defining processes is typical at the inception of TQM in an organization. Another way to recognize how often the significance of this step is overlooked and underestimated is to do the following. In

your next meeting, ask each individual: What is the process under discussion now (ask for it to be written down) and exactly what step in the process are we evaluating?

Feedback is necessary to quantify success and quality of the process.

Process definition is often referred to as flow charting.

Process Evaluation. Each team is responsible for evaluating the processes it owns from a system-wide perspective. In the example above, evaluation of the 120 process steps revealed that approximately 70 steps actually added value and were germane to the overall goal of the process. The other 50 were non-value added steps. Removal of the non-value steps improves quality by eliminating waste in the overall process. It allows clearer focus on the essential steps, and it reduces cost of the overall process. Revealing the visibility of critical steps in a process allows further analysis of cost and effectiveness trade-offs of those critical and costly steps of the process. Find the word value in eVALUation to enlighten the notion of value added and non-value added steps.



Ref. NPDRC

Value also refers to quantifiable knowledge. Quantitative feedback allows us to examine the success and quality of our process. Remember, if you can't measure it, it probably has no value. The basic tools (see Figure 3) and the Plan-Do-Check-Act (PDCA) cycle (see Figure 4) are tools that facilitate the evaluation of processes and system-wide activities. Quantification eliminates arguments concerning whose fault a problem may be, or whether the steps in the process have value or not. Quantification of the problem combined with the supportive environment of a team allows resolution of the problem without finger-pointing. (An additional seven-management tools offering is particularly useful for administrative and service applications.)

Another VALUE to consider is process ownership by a team. Team ownership of processes is an important behavior science concept integrated into TQM. Ownership of processes elicits positive employee responses like pride of workmanship, job control, job satisfaction, a customer focus, a mission statement focus, and an incentive for continuous improvement. Teams and their members have a good feeling owning a process.

Continuous Improvement Process

Employee ownership of processes is necessary to obtain maximum improvement. Using the feedback and quantification tools allows us to focus on significant cost and quality steps in the process (See Figure 5). As an example of the dedication required of management to employee ownership of processes, consider the ownership of your home. You improve your home continuously by painting, redecorating, adding new carpet, cutting grass, buying new appliances, etc. But, would you expect your neighbor to im-

prove your home? Of course not. So, as managers we must delegate responsibility of continuous improvement to the owners of the process. Employee/ team ownership of processes provides job control that leads to job satisfaction. Just as we continuously improve our homes, we as teams, and our employees as teams will improve processes.

The acid test is this: In your next meeting, separate each individual and ask what process each was working on in the meeting and what are the process steps. Would they agree? That would be the process definition verification. Then, you could say: "Show me how and what you're doing to improve those processes."

As a manager, you have just empowered your personnel to do total quality management. The steps of this final paragraph just made you the "One Minute TQM Manager."

Mr. Aaron is the Deputy Director of the Close Combat Directorate, OTEA.

FIGURE 4. THE "PLAN-DO-CHECK-ACT" CYCLE DURING PROCESS IMPROVEMENT

USE OF "PLAN-DO-CHECK-ACT" CYCLE

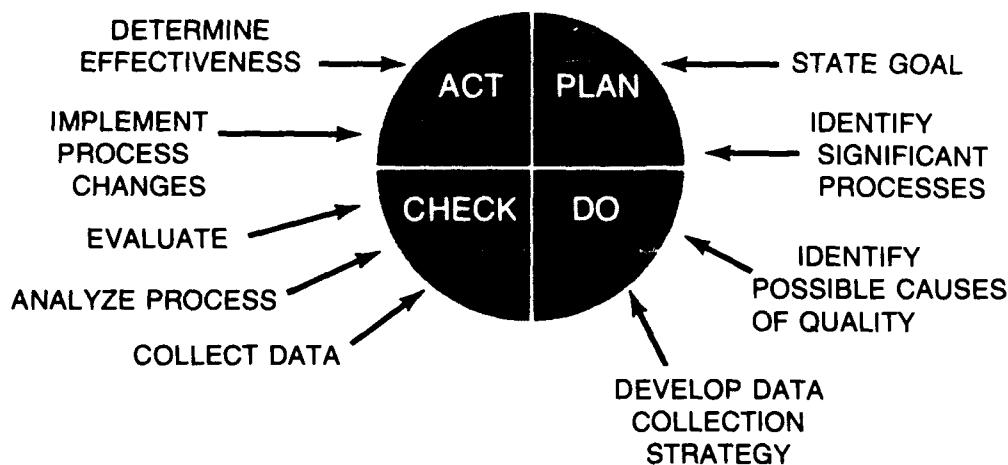
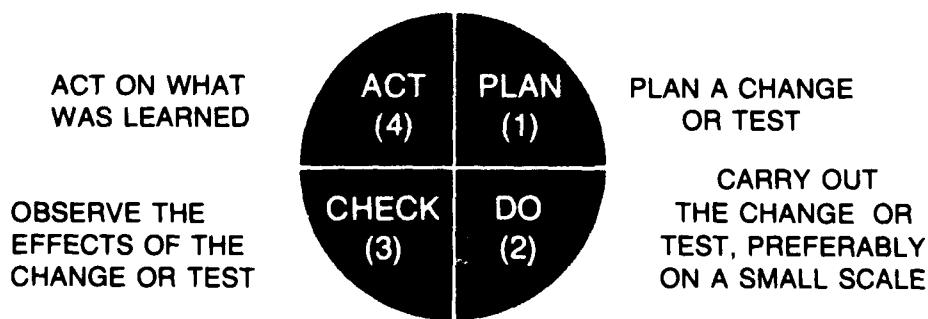


FIGURE 5. THE "PLAN-DO-CHECK-ACT" CYCLE FOR CONTINUOUS IMPROVEMENT

**THE SHEWHART CYCLE
(Deming, 1986)**



5. REPEAT STEP 1, WITH NEW KNOWLEDGE.

6. REPEAT STEP 2, AND ONWARD.

RESULTS OF DSMC's PROGRAM MANAGER COMPETENCY STUDY

Dr. Owen C. Gadeken

What characteristics distinguish DOD's best acquisition program managers? The Defense Systems Management College (DSMC) sought the answer to this question in a recently completed study which identified the competencies (technical expertise, management and leadership skills) possessed by a select group of program managers from the Service acquisition commands. The study was based on the premise that the best way to find out what it takes to be a good program manager is to analyze the job's outstanding performers and identify what they do that makes them so effective. The study included in-depth interviews with program managers and a follow-on survey of acquisition professionals. An earlier *Program Manager* article outlined the job competency assessment process used in the study and its theoretical base.¹ This article presents study findings and recommendations.

Study Methodology

The interview sample consisted of 56 program managers and deputy program managers from the Army, Navy, and Air Force acquisition commands. This sample included major and non-major programs, and programs in each phase of the acquisition life cycle.

Two groups of program managers were selected for interviews: a group of outstanding performers and a contrasting group of effective (or more typical) performers. Nominations were received from the program executive officer (PEO) level in each Service. In addition, a competency assessment survey, completed on each nominee by several peers and subordinates, was used to clarify the final nomination categories. The two groups were used to identify competency requirements of program managers (those shared by both groups) and competencies that distinguish the outstanding performers from their contemporaries. The

identity of the groups was kept confidential: neither the interviewers or interviewees were given this information.

The interviews generated 217 critical situations involving the *program managers*. Situations described most frequently were contracting (47), personnel management (31), test and evaluation (26), and budgeting and funds management (19). The interview transcripts were analyzed and then systematically coded to identify distinguishing characteristics exhibited by the program managers. These specific behaviors were grouped into related categories and given descriptive names by the research group. This constituted the preliminary competency model.

Since the interview sample was relatively small, a follow-on survey was conducted to validate the competency model and test its relevance to a broader group of acquisition professionals. The written survey required participants to prioritize separate lists of competencies and acquisition knowledge areas and indicate in which areas they most needed training.

Program Manager Competency Model

The final *program manager* competency model is displayed in Figure 1. Competencies were grouped by factor analysis; i.e., those tending to occur together in the interview data. Competency names and descriptions are listed below:

1. **Sense of Ownership/Mission.** Sees self as responsible for the program; articulates problems or issues from broader organizational or mission perspective.
2. **Political Awareness.** Knows who influential players are, what they want and how best to work with them.
3. **Relationship Development.** Spends time and energy getting to know program sponsors, users and contractors.

FIGURE 1. PROGRAM MANAGER COMPETENCY MODEL

16 Competencies

- * 1. Sense of Ownership/Mission
 - * 2. Political Awareness
 - * 3. Relationship Development
 - * 4. Strategic Influence
 - * 5. Interpersonal Assessment
 - 6. Assertiveness
 - 7. Managerial Orientation
 - 8. Results Orientation
 - 9. Critical Inquiry
 - 10. Long-term Perspective
 - 11. Focus on Excellence
 - 12. Innovativeness/Initiative
 - 13. Optimizing
 - 14. Systematic Thinking
 - * 15. Action Orientation
 - 16. Proactive Information Gathering
- *Competencies which distinguish outstanding from effective program managers (at $p < .03$) based on frequency of demonstration

- 4. Strategic Influence. Builds coalitions and orchestrates situations to overcome obstacles and obtain support.
- 5. Interpersonal Assessment. Identifies specific interests, motivations, strengths and weaknesses of others.
- 6. Assertiveness. Takes or maintains positions despite anticipated resistance or opposition from influential others.
- 7. Managerial Orientation. Gets work done through the efforts of others.
- 8. Results Orientation. Evaluates performance in terms of accomplishing specific goals or meeting specific standards.
- 9. Critical Inquiry. Explores critical issues that are not being explicitly addressed by others.
- 10. Long-Term Perspective. Anticipates and plans for future issues and problems.
- 11. Focus on Excellence. Strives for the highest standards regardless of circumstances.
- 12. Innovativeness Initiative. Champions and pushes new ways of meeting program requirements.
- 13. Optimizing. Makes decisions after carefully evaluating advantages and disadvantages.

14. Systematic Thinking. Organizes and analyzes problems methodically.

15. Action Orientation. Reacts to problems energetically and with a sense of urgency.

16. Proactive Information Gathering. Systematically collects and reviews information.

Further analysis of the interview data revealed that the subgroup of outstanding program managers scored significantly higher on six of the competencies. These are coded (*) in Figure 1. All but one of these competencies relate to managing the external environment.

On first cut, it would appear these results imply that the best program managers are the strongest program advocates or even salesmen. Program manager advocacy without regard for the technical merits of the program is an historic flaw in the acquisition process, now strongly discouraged by policy.² While advocacy appears in the data, it is far from the central theme distinguishing the outstanding program managers: building and maintaining effective external working relationships to resolve significant program issues.

As an example of Sense of Ownership Mission, a program manager described his frustration at being potentially frozen out of a key meeting:

Why did I want to get involved in the treaty? The reason is that it affected my system. I am in charge of the full systems management. That is my system. You better talk to me. If you won't talk to me, I will kick down your door. If you throw me out, I will go find somebody else or I will come in your back door. I am responsible for this system.

Another program manager used Strategic Influence to gain support for his acquisition strategy:

I finally recognized that I needed heavy hitters with more influence and authority than I had, so I got a meeting with the program executive office, the head of procurement, my staff, an attorney advisor, the Army's contract policy expert. In other words, I had to go in there and literally stack the deck in terms of influence and independent representatives who would vouch for what I had said.

FIGURE 2. SURVEY VALIDATION OF PROGRAM MANAGER COMPETENCIES

Competencies	RANK ORDER OF IMPORTANCE	
	Program Managers (N=128)	Other Acq. Professionals (N=225)
Sense of Ownership/Mission	1	17
Long-term Perspective	2	22
Managerial Orientation	3	21
Political Awareness	4	18
Optimizing	5	2
	↓	
Professionalism (Technical Expertise)	23	1

Several subcategories of interview participants were compared. However, minimal differences were found in competencies across the Services, program phase or program size.

Competency rankings from the follow-up survey (as illustrated in Figure 2) correlated very well with the competency model. Only 1 of the 16 competencies in the model (assertiveness which is not socially desirable) was ranked by program managers lower than 18 in a pool of 27 competencies (additional socially desirable characteristics were added to make the ranking more rigorous). In contrast, the acquisition professionals' rankings for their jobs reflected a very different set of competencies. For example, professionalism (defined as technical expertise) was ranked 1st by acquisition professionals and 23rd by program managers (see Figure 2).

These data imply that acquisition specialists and program managers require significantly different competencies. This also suggests that the transition from functional specialist to program manager may be conceptually quite difficult. A review of the literature supports this conclusion.³

Acquisition Knowledge Areas

As part of the survey, respondents were asked to rank the importance of acquisition knowledge areas for their jobs. Program managers and acquisition professionals emphasized the policy and management knowledge areas as shown in the first column of Figure 3.

Training Needs

Survey respondents also were asked to identify acquisition knowledge areas and competencies where they could most benefit from additional training. When compared to the survey importance ranking, fewer respondents identified training needs in either category. As shown in the second column of Figure 3, program managers and acquisition professionals emphasized software and several business management functions for additional training. These training needs differ considerably from the importance categories in the first column. One possible explanation is that respondents felt more satisfied with their level of acquisition policy and management knowledge than with other supporting functional disciplines, especially those in the business area.

None of the competencies were emphasized for additional training (based on the 33 percent threshold used in Figure 3). The most requested was interpersonal assessment at 22 percent. Several factors may have contributed to this result. The program manager and acquisition professionals were not aware of this study which identified the competencies as being critical to effective performance. They may lack objective evaluation of their competencies or assume they possess them by virtue of their managerial experience or professional education. Finally, they may perceive such competencies as natural talents and therefore not trainable. Further analysis is needed to clarify this result.

Summary of Findings

- I. Sixteen competencies were identified from program manager interviews and confirmed by a follow-on survey.
 - II. Six of these competencies, based on frequency, most differentiated outstanding from effective program managers.
 - III. Acquisition professionals identified and prioritized a different set of competencies than program managers.
 - IV. Minimal differences exist in the 16 competencies across the Services, program phase or program size.
 - V. Program managers and acquisition professionals emphasized the importance of acquisition policy and management knowledge areas.
 - VI. Program managers and acquisition professionals reported a need for training in software and several business functions.
- Recommendations**
- This study was done to provide data to improve program management performance by identifying competencies required of effective program managers. The first recommendation is to make the acquisition community aware of the competencies found in this study. This article, the upcoming final study report, or a briefing by the research team could serve this purpose.

FIGURE 3. ACQUISITION KNOWLEDGE AREAS AND TRAINING NEEDS

The second recommendation is to use the study results to assess the compatibility of current acquisition training content and methodologies with the program manager competencies. "Too often training programs attempt to 'teach the fundamentals' using lectures, readings, case discussions, films, and dynamic speakers to transmit knowledge to course participants. Unfortunately, it is usually not the lack of knowledge, but the inability to use knowledge that limits effective managerial behavior."⁴ The nature of the competencies (management and leadership skills) suggests that acquisition training programs need to move beyond structured presentation of acquisition knowledge to integration of these knowledge areas with the higher order skills (competencies) necessary to be effective in real-world situations faced by the program managers in our study. Experience with the Looking Glass management simulation at DSMC⁵ suggests that senior military and civilian acquisition managers may still need considerable improvement in many of the identified competencies, even though they have extensive prior management experience and professional education.

Practical exercises stressing program management problem solving and decision-making in real acquisition situations would be most likely to succeed with such students. These exercises must be followed with evaluation and feedback to students on how their individual competencies contributed to, or detracted from, effective performance on the exercises. Students' needs for training will vary widely. This suggests course electives grouping students with similar development needs, and personal development plans and continuing education opportunities after students return to their jobs.

The third recommendation is to use study findings to help structure Service acquisition career paths. Entrance into acquisition career fields and selection for training and development assignments should be based as much on competencies (especially for key assignments) as on knowledge and experience.

	Important for Job ¹	Training Needed ²
ACQUISITION KNOWLEDGE AREAS		
Systems Engineering	X X	
Logistics		
Manufacturing/Production		
Fielding		X X
Software		
Test and Evaluation		
ACQUISITION MANAGEMENT		
Cost Estimating		X X
Budgeting and Funding	X X	X X
Management		X X
Contracting		X
Contract Finance		
Cost/Schedule Control		
Systems		
ACQUISITION POLICY		
Acquisition Policy	X X	
Acquisition Strategy	X X	
Acquisition Organizations	X X	
MANAGEMENT AND POLICY		
Systems Management	X	
Management Practices	X X	
Personnel Management	X X	
Joint Service/Multinational Program Management		

X = Indicated by (128) Program Managers

X X = Indicated by (128) Program Managers and (225) Acquisition Professionals

¹At least half the respondents indicated high level of expertise was needed for their job.

²Identified by at least a third of respondents.

Finally, to aid in implementing the above recommendations, further research is needed to identify the extent to which program manager competencies are important to other key acquisition positions (chief engineer, business/financial manager, logistics manager and contracting officer). Considering the program office as a team, it would be useful to identify competencies required by all key acquisition professionals and those that may be compensated for if possessed by other members of the group. Also of interest is the identification and comparison of industry program management competencies with those of their DOD counterparts.

Endnotes

1. Gadeken, O. C., "DSMC Studies Program Manager Competencies," *Program Manager*, Jan.-Feb. 1989, pp. 42-44.

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4. Boyatzis, R. E., "The Competent Manager: A Model for Effective Performance," Wiley-Interscience, New York, 1982, p. 4.

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HERE WE GO AGAIN!

ACQUISITION REFORM REVISITED

Lieutenant Colonel Jerry R. McMahan, USAF

During the 1980 presidential election, Candidate Ronald Reagan used the line "There you go again" to advantage. Recently, a group of active program managers met at George Mason University to explore again fundamental problems with the acquisition process. But there were differences between this effort and previous efforts; i.e., the Carlucci Initiatives, Grace, and Packard Commissions. The participants were active program managers (PMs), people with continuing experience and considerable expertise were evaluating the current engineering/product development process; reflected the 1950 concept that good management required knowledge of the process to be managed; and had a common product orientation and background, "Smart Munitions."

Before those not interested in bombs and bullets stop reading, let me amplify what I mean by smart munitions: Once fired from a gun (or dropped from an aircraft), a simple bullet (or bomb) continues along its predetermined path until it hits a target or otherwise expends itself. But, smart munitions are more like aircraft, tanks and ships than bullets and bombs. Smart munitions can change their initial trajectories to respond to changes in target location or other changes to target signature characteristics. They have on-board computers and/or guidance sets that assist the operator significantly by using technology to augment skills. Smart munitions are more like people, changing action to suit the circumstances and, like people, are complex products. Examples include AMRAAM and Sparrow Air-to-Air missiles, Copperhead, AROC, HARM, Cruise Missiles, and our latest generation of torpedoes.

More Expensive

Because these kinds of systems are inherently more complex, they are more expensive. With future weapons predicted to become more complex still (e.g., "Brilliant Munitions"),¹ we can anticipate commensurate increases in their cost. The decrease in defense budgets, coupled with increased need, caused senior-level OSD personnel to focus attention on a real challenge—*How Do We Improve Smart Munitions Acquisition?*

To meet this challenge, Dr. Robert B. Costello, who was then Under Secretary of Defense (Acquisition), tasked tactical munitions people to examine the situation and develop recommendations for potential solutions to problems found with the present acquisition process. Anthony Melitta, Office of Munitions, was appointed project manager. He asked the Defense Systems Management College (DSMC) to help develop information and ideas.

The George Mason University Center for Interactive Management which had previously helped DSMC perform similar activities, was asked to assist. Dr. Alexander N. Christakis, a leading practitioner of interactive management techniques, was facilitator for the process.² Henry Alberts, DSMC, and Tony Melitta assisted.

Focusing

The interactive management technique is a disciplined mechanism which acts to focus group discussion; adding that focus makes the interactive management process more efficient. A further refinement is the incorporation of logical inference relationships into computer routines to sort and manipulate ideas the group develops. This process and large-screen TV projection capability significantly enriches group dynamics and the creative process generally. Selective readings on interactive management are included in the bibliography of this article.

A two-step process was used. First, the group developed a set of problems (inhibitors) that PMs experienced in doing smart-munitions development. Solutions to those problems were proposed. Small (7-12 people) groups of government and industry program managers met in four, 3-day sessions. Each developed a set of inhibitors and potential solutions. Group membership was drawn from Air-to-Air, Surface-to-Air, Air-to-Surface, and Surface-to-Surface mission area groups. Representatives from the Anti-Submarine-Warfare community were incorporated within the last two groups.

At the end of each session, each work group selected two representatives to participate in a final group discussion of the total product of all four workshops. In addition to representatives from each work shop, this task force was composed of senior representatives of OSD and each of the Services. The task force reviewed challenges and potential solutions and further refined and focused them.

The four "Smart Munitions" work groups developed 287 inhibitors to smart munition acquisition effectiveness. These were aggregated by the task force into 15 overall categories shown in Table 1.

Mr. Alberts noted early-on that a common theme surfaced from the four group discussions: The inhibitors defined by both groups were neither weapon system nor munitions specific. They were generic to the acquisition process itself. The task force confirmed this observation. It found considerable similarity between findings of this set of work groups and other completed studies. The task force not only focused the product of the four previous work groups, but

TABLE 1. ACTION OPTION GROUPINGS

II	Budgetary Considerations
IV	Testing
VI	P31
VIII	Program Control
X	Scope of Government Activity
XII	Specification Tailoring
XIV	Staffing

consolidated ideas and assigned responsibility for implementation of each potential problem solution produced by this process. The 29 action options were developed within the first three action option groupings: PM Authority, Budgetary Considerations, and Requirements.

Dr. Costello was briefed on functions of the total "Smart Munitions" effort and potential solutions the task force developed. What might happen as the result of this work is speculative. Two observations may offer some insight.

1. Expectations for an improved acquisition process have been raised. Certainly, program managers who participated in this effort are expecting, to various degrees, fundamental changes in the way we do business. Since each of these PMs is an articulate, success-oriented individual, some changes will occur regardless of senior management's receptiveness to change. This level of change is at "the grass roots." Because of that, it may in the long-term be more meaningful and more lasting. But, grass-roots change by nature is somewhat glacial in speed but, at the same time, is long-lasting. Just as the French Revolution served as precursor to real reform which came with the 1848-1860 revolu-

tions,³ this effort involving active PMs has heightened expectations for a better process. Because some of these PMs will likely be the Senior Service, OSD and industry policy-makers for acquisition a few years hence, we can expect insights they gained during this process to become the foundation for long-term changes.

2. Anyone reading the *Washington Post*, *Newsweek* or other media is aware of significant public desire for acquisition reform.⁴ Speculation centered about the need for an extremely adept politician, or a highly capable process reformer. Not only are the Congress and the body politic clamoring for process reform but, at the same time, we appear to be starting a new era of declining defense budgets.

Because we are at a time when the public appears to desire reform, some issues pointed out by this series of workshops will likely be addressed. Policies that implement change may not be perfect but there is at least one significant difference from previous efforts: Active working-level program managers participated in development of problem statements and solution options. As a result, some flaws inherent in "mandates from above" may be eliminated and a better acquisition process will be facilitated.

The active PMs are especially grateful to Dr. Costello for championing this approach to reform. With a better understanding of the process and some definition of the challenges and options for improvement, a "Champion" (or several of them) may emerge to take up the torch and "make reform happen." Achieving acquisition reform is certainly a leadership challenge.

Endnotes

1. Edgar E. Ulsamer, "Brilliant Weapons Gather Momentum," *Air Force Magazine*, August 1988, pp. 74-80.

2. Some excellent sources of information on interactive management include an abstract in the *General Systems Yearbook of the International Society for General Systems Research* Vol. 111 authored by Alexander N. Christakis, 1987, pp 69-75. John N. Warfield, "The Magical Number Three--Plus or Minus Zero," *Cybernetics and Systems: An International Journal*, Vol. 19, 1988, pp. 339-358. J. N. Warfield and A. N. Christakis, "Dimensionality," *Systems Research*, Vol. 4, No. 2, 1987, pp. 127-137.

3. J. J. Talmon, *Romanticism and Revolt Europe 1815-1845*, Harcourt, Brace & World, Inc., (Jarrold & Sons Ltd.) Norwich, England, 1967. Provides ideas that came from one great revolution and led to the series of real changes that occurred in 1848 revolutions of Europe.

4. A literary search of periodicals published on "acquisition reform" revealed 127 titles dealing with that topic from October 1988 to January 1989. Among those are: David Hoffman, George C. Wilson, "Bush, Seeking Defense Aides, Meets With Martin Marietta Chairman," *Washington Post*, Dec. 1, 1988, Sec 1, p. A29. Ann McDaniel, Douglas Waller and John Barry, "Twisting in the Wind?" *Newsweek*, December 12, 1988, p. 25.

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PRODUCTION COMPETITION

LESSONS-LEARNED: ELEMENTS OF A BUSINESS DEAL

In many weapon system programs, the government must negotiate with the incumbent producer to obtain some level of cooperation in establishing a competitive production source for the incumbent's system. This second of our lessons-learned articles describes some negotiable elements we have seen in business deals between the government and sole-source incumbents.

Our objective is to make it clear that government personnel have many levers to apply to uncooperative incumbents. We want program managers to be able to answer contractors who challenge government competition plans with such questions as: "Why should I do anything to help the government create a competitor who will take away my business?"

Assume in the following discussion that the government objective is to obtain the incumbent's agreement to perform a leader-follower technology transfer program. Keep in mind that a leader-follower program requires that the developer (leader) be *responsible* for second source (follower) production qualification.

Time Elements

There are critical milestones to be negotiated with the developer in constructing a leader-follower program. Some of these are:

- Leader starts work
- Leader receives the definitized contract for the program
- Follower is selected
- Follower starts work
- Follower is qualified for initial production
- Follower is qualified for rate production
- First competitive production buy
- Competition for logistics and other support services begins
- Competition for system design changes begins
- The dates upon which the contract's various financial incentives expire.

Ordinarily, government preferences regarding the above dates will be different from the incumbent's. For example, the government would want the leader-follower program initiated as early as possible, so that the follower could be

production qualified at the earliest possible date—to minimize sole-source production business.

It is important to note that these contrasting motivations, which are present in all the business deal elements, permit the government to move off its position on one element in exchange for the incumbent's movement on another. For example, the incumbent may agree to accept responsibility for early production qualification of a follower, provided the government relents on another milestone or concedes on one of the other business deal elements discussed below (such as providing the incumbent with a significant role in follower selection).

It is important to note that milestones listed need not occur in that sequence, if the parties agree. For example, it is possible to initiate the competition for an annual buy before the follower is formally production qualified, with contracts awarded to winner and loser after qualification is complete. Note that, here again, motivations of the government and the leader conflict at the particular point under discussion, providing negotiation trade-off opportunities.

Other timing issues could be important to one or the other of the parties and could, therefore, be written into the business deal. As will be seen below, other elements of the business deal can be structured to provide the government with the leverage required to ensure contractor performance in accordance with negotiated milestones.

Cost Elements

Cost considerations (who pays how much, for what, when) are always key elements of any negotiation, but competitive programs have a number of unique cost elements that must be accounted for. These include:

- The cost of the second source's special tooling and special test equipment
- Follower costs for technical data package review, for design and manufacturing engineering efforts, and for production line start-up
- Leader costs to support follower selection, technology transfer, and production qualification
- Cost of additional qualification and testing units
- Cost of government effort to monitor the program and provide independent testing.

*Bill Drinnon
David Hodulich*

Modernization Element

The program manager may agree to support an incumbent's modernization program—a program that promised reduced production costs. Investment in such programs would increase the incumbent's competitiveness and would be in the government's interests, providing a rare "win-win" negotiation element.

On the other hand, government financial support of a follower's modernization program would not be in the incumbent's interests. So, the incumbent's fall-back position concerning modernization programs may be that the government should agree not to participate in any modernization program that gives either source a competitive advantage.

Because special tooling and test equipment costs are usually one of the largest cost elements in bringing on a second production source, they frequently become one of the key issues in the business deal negotiation. Incumbent contractors typically insist that the second source pay the bulk of these costs as a front-end investment and then amortize that investment during production. Incumbents point out that they have already made substantial investments in the program and that a second source should do the same. The government may prefer another arrangement.

Quantity Elements

There are two problems in determining how the annual production awards are split between the two producers. The first is to calculate that rate below which plant operating efficiencies drop to unacceptable levels. The second is to identify the minimum annual award quantities required to keep the contractors competitive for the next year's buy. Contrary to intuition, there is no generally accepted procedure for calculating these figures with precision. Accordingly, these issues are resolved through the negotiation process, with the incumbent pressing for high minimums for himself (and low minimums for the second source).

Quantity guarantees typically have a time dimension. For example, the government might agree to the leader's retaining some minimum percentage of the first three annual buys, with subsequent awards split between the competitors in any manner considered by the government to be in its best interest.

Quantity guarantees frequently are tied to other elements of the business deal as incentive for leader achievement of certain milestones. For example, the government could guarantee the leader 25 percent of the annual buy for 2 years if the follower were qualified by a certain date, with a schedule of higher guarantees tied to early qualification dates (or lower guarantees tied to late qualification). The time period during which the guarantees apply can be shortened or stretched to encourage the leader to qualify the follower as early as possible.

Buyout Element

The buyout element concerns how long the government will sustain the two competitors before electing to run a buyout on the program.

Obtaining government agreement to delay program buyout can be important to developers, who frequently require sustained production runs to amortize their large research and development tooling, and test equipment investments. Such developers fear low-cost second sources, who may not have made substantial investments in the program and who are, therefore, likely to win a buyout program (early winner-take-all buyouts are of special concern to previously sole-source developers).

On the other hand, government interest concerning buyouts, everything else equal, is to reserve the right to run the buyout whenever it chooses.

Because special tooling and test equipment costs are usually one of the largest cost elements in bringing on a second production source, they frequently become one of the key issues in the business deal negotiation.

Derivative Business

A developer agreeing to establish a second source for his product will want to limit the second source's rights to produce the system. For example, he will try to retain exclusive rights to develop and produce:

- System upgrades required by the government
- Commercial versions of the system
- Variants offered for foreign sale.

The developer can attempt to protect these markets via restrictive licensing arrangements with the second source. The program manager can either accept such arrangements or preclude them from the leader-follower program he finally buys from the developer.

Obviously, the developer will be prepared to offer much of value to obtain government agreement to derivative business restrictions.

Support Functions

As with derivative business, the developer will seek to prevent the second source from participating in the logistics and engineering support of the deployed system. Because the government typically spends more in support of a deployed system than it spends in producing it, retaining support business is very important to the incumbent. On the other hand, the government should be reluctant to perpetuate sole-source support of the system, without receiving some major concession from the developer in another element.

Contractor support issues do not need to be negotiated on an all-or-nothing, now-or-never basis. For example, logistics support could be competed, but design agency responsibilities could be left with the

Because the government typically spends more in support of a deployed system than it spends in producing it, retaining support business is very important to the incumbent.

developer. Or support responsibilities could be left with the developer for some specified number of buys—then competed. Or, support contracts could be restricted to the two system producers, rather than fully opened to competition.

Similarly, support contract agreements can be tied to other business deal elements to leverage developer performance with regard to technology transfer and second-source production qualification. For example, the government could agree to let the leader retain, on a sole-source basis, program logistics for a couple of years after production competition starts, provided that follower qualification occurs on time. The government, in effect, would be gaining price leverage on the early production buys, in exchange for competition forgone temporarily on logistics support. A developer might find such an agreement acceptable in itself, or an agreement here might have to be coupled with agreements in other elements.

Long Lead Items

For many systems, long lead materials must be ordered months in advance of contract award for the system itself. In competitive production programs, it is usually not possible for each producer to procure his own long lead items, because individual production quantities are not known until months after the long lead items must be ordered.

There are two ways to handle the problem:

- The government can procure all long-lead items from the vendors and furnish them to the two prime contractors as government-furnished equipment (GFE) when the production split is decided.

- The government can procure all the long lead items from the incumbent, letting him purchase them from the vendors and furnish the items to the follower when the production split is decided.

Incumbents profit in the latter case, and the government avoids a GFE situation, so the contractor-furnished alternative is probably a "win-win" solution to the problem. Note also that, in a properly structured leader-follower program, it is in the incumbents' interests to manage long-lead item responsibilities properly, because he is responsible for ensuring that the follower is ready to compete for the designated first competitive buy. If long-lead items are delivered late to the follower by the leader, the follower will not be capable of meeting contract requirements, and the leader will be penalized in accordance with the provisions of his leader-follower contract with the government.

Source Selection

In any leader-follower program, there will be two types of source selections:

- First, to determine the follower
- Second, to determine the annual production quantity splits between the two sources.

Source selection plans of both types are of great interest to the developer.

Certainly, the developer will press hard for the right to select the follower unilaterally, based upon the government requirement that the leader guarantee timely follower qualification. If the developer is given source-selection authority, the government should approve the leader's detailed plan for selecting the second source and should approve the source selected. But, the government agreement to assign source-selection authority to the developer should come only with unqualified developer agreement to accept total responsibility for the second source's timely qualification.

The developer will want to participate in developing the plan for splitting quantities when competitive production begins. For instance, the leader will want to influence development of government criteria for determining the splits, which might be based upon:

- Price alone
- Some weighting of price offered, quality achieved, and schedule accomplished
- One of the above coupled with performance against other specified program objectives (like timely second-source qualification).

Of course, the government in the end will establish these criteria, but it can agree to consider the incumbent's suggestions.

Program managers should expect incumbents to pay dearly for source-selection responsibilities. Incumbents usually feel they can select and qualify a competitor less threatening to their overall business base (government and commercial) than one the government might select. The trick, on the part of government, is to ensure that the selected follower is the superior second source for the system under consideration—but selected from those to whom the leader will transfer his technology and guarantee production qualification.

Fee

The fee element in a production competition business deal is straightforward. The profit motive assures the incumbent's interest in capturing the maximum fee possible, so the government should tie fee to achievement of specific key milestones. It is important, however, that the government calculate the value to the developer of his failing to achieve a milestone, before putting substantial reliance on some award fee to obtain developer-government goal congruence. For example, the leader may cheerfully forgo a million dollar fee tied to follower qualification—if failure to qualify the second source will prolong a lucrative sole-source situation.

Other Incentives

Other incentives, positive and negative, are frequently found in leader-follower program business deals. For example:

- Progress fee rates can be tied to the leader's timely achievement of specified milestones
- Leader-follower program award fees can be a function of the competitiveness of the second source's production prices
- The government can agree to restrict any portion of the program, for any period of time, to the leader and the follower—for as long as specified objectives are met.

Creative government acquisition planners are continually developing innovative business deals, so any program manager considering a leader-follower program would be well advised to review recent programs as one of the first steps in developing his negotiation plans.

Summary

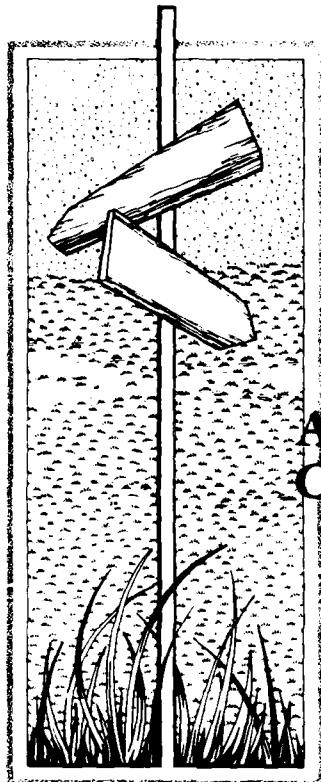
This discussion of business deal elements should make it clear that the government has much to offer an incumbent considering whether or not to participate in a leader-follower program. It needs to be stressed, however, that elements discussed are representative of matters to be resolved in such negotiations—additional issues will arise and some elements mentioned will be irrelevant in specific circumstances.

Keep in mind that our discussions focused specifically on negotiating with the incumbent in a leader-follower program. However, the program manager understanding elements of business deals with leader companies will be able to develop similar plans for dealing with followers (in leader-follower programs), and with both the incumbent and potential second sources in other kinds of technology transfer programs.

Negotiating the Deal

This article cannot describe and discuss specific negotiation techniques, and we cannot here provide guidance on how to negotiate specific business deals and turn them into contracts. We suggest that government personnel would do well to strengthen their negotiating skills through readings in such books as: Howard Raiffa, *The Art and Science of Negotiation*, Harvard University Press, 1984; James K. Sebenius and David A. Lax, *The Manager As Negotiator: Bargaining for Cooperation and Competition Gain*, New York, The Free Press, 1986.

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ALTERNATIVE CONTRACTING/ACQUISITION STRATEGIES WITHIN DOD

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In government program management, two key players, the project manager (PM) and the contracting officer, share the responsibility of system acquisition. The project manager is charged with obtaining necessary items to fulfill government needs and works closely with the contracting officer, who has the authority to enter into contractual agreements with firms for acquisition of products, supplies or services.

The modern-day project manager within government acquisition is faced with a complex problem of developing acquisition and contracting strategies within an ever-changing framework of constraints. The project manager must define the type of contract to use with help of the contracting officer. The two families of contracts to choose from are fixed-price and cost-reimbursement. The project manager will choose the appropriate contract category and particular type of contract within that category by applying certain ground rules associated with the amount of financial risk involved. In addition, the project manager must organize and operate within latest government regulations and initiatives.

"The Federal Acquisition Regulation Part 34 requires the PM to develop a written acquisition strategy which is an overall plan for satisfying the mission need. With support from various specialists, he must estimate costs, obtain budget authority, and provide requirements and funding to the contracting officer to obtain goods and services by contract."¹ Thus, to be successful, the project manager and contracting officer must cleverly shape contracting and acquisition strategies for various phases of the system life cycle.

Body

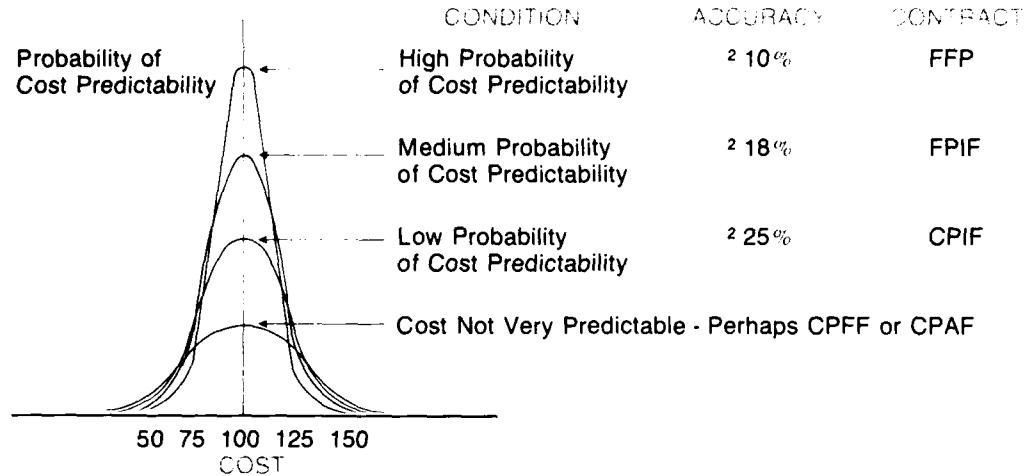
To begin a discussion of contracting strategies, you should examine two basic categories, or families of contracts: cost-reimbursement (where government pays the cost, subject to limitations on allowability, allocability, and reasonableness); and fixed price (where government pays a price, subject to some fixed maximum ceiling amount if a sharing incentive is used).²

Key features of a fixed-price contract are: contractor promises to deliver on time, per specification, for a fixed price, and government promises to pay the fixed price if the product/service conforms to the contract.

Cost-reimbursement contract features differ as follows: contractor promises best effort to perform on time, per specification, and below "estimated costs" if the government both funds and promises to pay all allowable, allocable, and reasonable costs plus fees, in accordance with the contract.

The amount of the contractor's cost risk depends on the type of contract chosen. For example, a fixed-price contract places more cost risk on the contractor than would a cost-reimbursement contract. There are different cost-reimbursement and fixed-price contracts with, more or less, cost risk associated with each. These include: Cost Plus Fixed Fee (CPFF), Cost Plus Award Fee (CPAF), Cost Plus Incentive Fee (CPIF), Fixed Price Incentive Fee (FPIF), Firm Fixed Price with Escalation (FFPE), and Firm Fixed Price (FFP). These are listed here in ascending order of contractor cost risk.⁴ The project manager must match the cost risk of development or production to the appropriate contract type.

FIGURE 1. MAKING THE SELECTION



To do this, the project manager must not only consider uncertainty of cost estimation (i.e., level of confidence that costs will turn out as predicted), but areas like performance and schedule risks associated with current life-cycle phase. Figure 1 is helpful in selecting the appropriate contract type.⁵

Target Cost Profit

Risk, ever present, must be addressed accordingly; i.e., one way is to offer incentives to the contractor. Areas like cost, technical performance, supportability and reliability may be incentivized. Incentive contracts seek to capitalize on profit-motivation of the contractor.

Cost-incentive contracts operate as follows, government speaking to contractor: 'No one knows *exactly* what the effort is going to cost. Let's discuss our estimates and reach agreement on a reasonable *target cost* and *target profit* (or fee). If you can do this work for less than the target cost (or underrun), I'll pay you the target profit plus a percentage of the underrun. If you spend more than the target cost (or overrun), I'll pay you the full allowable, allocable, and reasonable cost, but I'll reduce your profit by a percentage of the overrun.'⁶

Thus, in a cost-incentive contract, government and contractor share the cost risk by sharing underruns and overruns, within specified limitations.

Today, the government often incentivizes technical performance as well as cost. The project manager should observe basic ground rules when determining which technical parameters to incentivize. First, he should keep parameters to a minimum—three or four—for two reasons. Too many parameters dilute the value of each and the contract is more difficult to administer. With the exception of cost, parameters should be independent of one another.⁷

Second, for each parameter a minimum acceptable value and a highest desired value should be established. In setting minimum value, the project manager should ensure the value is reasonable. At the other end of the spectrum, the desired value should be achievable and should add to the system as a result of its achievement.

Finally, the project manager needs to determine how much money is available for incentives and how it should be distributed among parameters. He should consider how much he is willing to pay for maximum performance versus how much he is willing to pay for target performance. In distributing incentives, the project manager needs to establish relative importance of incentivized parameters. This can be done by assigning an expressed value, if calculable, or an implied value based on experience and best judgment.⁸

Motivation

In addition to explicit incentives, other methods can motivate the contractor. For example, incorporation of contract provisions like design-to-cost and design-to-unit-production cost can guide the contractor toward government goals.

Competition

With the advent of the Competition in Contracting Act of 1984, the government placed emphasis on cost savings and risk reduction through competition. Therefore, in structuring acquisition strategy with the contracting officer, the project manager should consider involving competition when possible. Competition can lead to cost savings, an increased industrial base and improved quality.

Let's look at a case study based on development of T800 multipurpose engines. Initial U.S. Army application of these engines will be in the new Light Helicopter Program (LHX). These competitive contracts included provisions that limited Army liability and increased the assumed contractor risk. Contracts were firm fixed-price contracts with contractor-funded facilitization and tooling including unprecedented guarantees for acquisition, operation and support costs. The contracts provided for production competition and guaranteed supportability in a manner that may be unparalleled in government procurement. In

exchange for increased contractor risk, standard military specifications were tailored while Army direction of the engine full-scale development program and contract data reporting requirements were minimized; meanwhile the contractor wrote his system specification. The contractor was free to schedule program events, accomplishments and milestones in the form of plans against which he was willing to be measured in competition. Lessons learned from the T800 experience are found in the *T800 After Action Report* and many are enumerated in following paragraphs.⁹

One of the government's latest initiatives has been contractor teaming. With the T800, two contractor teams were formed and awarded the FFP contracts. These teams were arranged as follows: APW, AVCO Lycoming and Pratt Whitney; and LHTEC, Allison Gas Turbine Division of General Motors and Garrett Turbine Engine Co. Both developed a company-to-company relationship for executing contract terms as a team.

The first U.S. Army target acquisition radar to be developed for a helicopter is the Airborne Adverse Weather Weapon System. The system will enhance Army aviation's survivability and lethality.

Advantages

Specifically, the following management methods which stand out as advantages were implemented to streamline the acquisition process: Army eliminated much counterproductive reporting; Army articulated program philosophy and requirements to the local plant representatives to avoid confusion among government monitors at the contractor's facility; contractor teams adopted a formal system engineering approach that facilitated coordination and consolidation of authority and responsibility for resources; and, contractors established early agreements permitting each team member to capitalize on the other team members' strengths, thus providing a better product.

Disadvantages seen in the management area include the following: Both teams initially underestimated time and effort necessary to satisfy requirements of a single engine design, producible at both contractor facilities; management of decision processes within each team moved slower than expected in some cases; increased attention to management in the teaming concept meant increased cost to contractors.

Production Competition

Another major area for consideration was production competition. Several advantages evolved from competition initiatives in the original Statement of Work; i.e., technology transfer has been promoted in areas previously considered protected by the participants. Also, expansion of the classes of vendors has resulted in more previously unknown suppliers.

There were several disadvantages. First, the teams exceeded planned costs in meeting competition initiatives, perhaps because the effort required was not well-understood.

Second, the government should realize that small business, perhaps economically disadvantaged, will be required to invest and share the risk of a firm fixed-price contract. In view of the flowdown of risks to small firms with limited resources, long-term commitments may prove difficult.

Last, caution must be exercised in transfer of rights to technical data when dealing with proprietary rights. Perhaps the government should look more at "limited reprocurement rights" rather than "unlimited rights." This would allow the government to obtain necessary data to manufacture end-items, or to produce spare parts to support the T800 engine while allowing the contractor team to maintain the right for commercial applications.

The requirement to ensure dual sources for a single team design has resulted in each team member investing heavy up-front emphasis on manufacturing methods and procedures. This emphasis, combined with the design-to-cost contract provisions, will help reduce risk significantly in transitioning from development into production.

In the technical area, noteworthy findings resulted from this new way of doing business. As mentioned, unnecessary language in the Request for Proposal was eliminated. However, in some cases, maybe the Army went too far since the contractor requested additional guidance. On the other hand, the new contractual philosophy embodied increased up-front emphasis on producibility, cost, reliability/maintainability, competition, manpower-personnel integration (MANPRINT), and integrated logistics support (this emphasis was realized by the increased weightings for the above areas in the weighting of evaluation criteria). Therefore, contractors have had to change old ways by now giving the above areas equal importance to the technical area and allowing these areas to influence design of the engine from the outset. In the past, many of these areas received little or no attention, then were "piecemealed" into the system after the design had been frozen.

Cost Elements

In the area of cost, there were three elements demanding full attention—fixed-price development, not-to-exceed production price, and operation and support cost guarantees. The competitive nature of these contracts led participants to improve cost guarantees,

resulting in a better overall program. Both teams made significant contributions to design-to-cost, operation and support (O&S) costs, and life-cycle costs. They conducted necessary trade studies to minimize initial risks and financial exposure. In fairness to the teams, the Army had to balance its desire for production competition against the teams' production and O&S cost guarantees; that is, full break-out of parts causes the business volume and production base with the prime contractor to go down, thereby increasing their costs.

Another problem was monthly cost reporting mandated by the Office of the Secretary of Defense. This was regarded as a non-value-added task by contractors and by many within the Army. It is recommended that the government provide relief from such reporting.

In November 1988, the Army announced the winner of the T800 full-scale development competition. The team of Allison and Garrett (LHTEC) was chosen to proceed into production, and will competitively produce the T800. Follow-on production contracts will be of a fixed-price nature.

As seen in the first case study, much flexibility can be afforded the contractor, even in a fixed-price environment.

The second case study, which involves a cost-reimbursable contract, employs many of the same government initiatives that were in the T800 contracts.

Case study two deals with development of a heliborne fire control radar and an accompanying Hellfire missile system with a radar seeker. This is the first U.S. Army target acquisition radar to be developed for a helicopter and is known as the Airborne Adverse Weather Weapon System (AAWS). This weapon system is being designed for use on the AH-64 Apache helicopter and for later use on the LHX. The AAWS is designed primarily for an anti-armor mission and will have a significant capability in adverse weather and battlefield obscurants. The system will enhance Army aviation's survivability and lethality.

Technological Risk

One of the main differences between this development program and the T800 is technological risk. The engine program technical risk was assessed as low, whereas the radar technical risk was assessed as medium. Not only was the technical risk higher, but there was much schedule risk associated with the radar program. This was a consequence of the AAWS program being an Army Streamlined Acquisition Program (ASAP). Essentially, the Army is trying to reduce its development and procurement timelines. One way to shorten the acquisition life cycle is to accept a certain amount of concurrency from one phase to the next. Traditionally, research and development programs are planned heel-to-toe. By using concurrency, significant time may be saved.

Two long-standing objectives of the Army AAWS project manager team are to field the system as soon as possible after demonstration of the critical technologies, and to provide for dual-source competitive production. With these objectives in mind, three alternative program approaches existed, all of which would ultimately provide competitive dual-source production.

—Merged or Joint Development. Merge the two independent concept design definitions: single development contracts—proof of principle (POP) and development/production prove-out (D/PP) phases—to a joint contractor team; competitive (at Lot I) dual-source production.

—Competitive Development Through POP. Two competitive parallel contracts for POP; a "fly-off" and down-selection after POP; a single D/PP award to the winner; second-source "leader-follower" production (competitive at Lot III).

—Competitive Development Through D/PP. Two competitive parallel contracts (like the T800) for POP and D/PP; a "fly-off" and down-selection after D/PP; second source "leader-follower" production (competitive at Lot III).¹⁰



1800 Engine Line Drawing

Joint Development Chosen

After a comparative assessment of these approaches, it was decided that joint development was preferred. Martin Marietta and Westinghouse formed a Joint Venture and are executing the POP development phase. Joint development benefits are best technical approach, earliest subcontractor/vendor participation or commitment, lowest cost development program, significantly lower production program costs, shortest times to production deliveries and fielding, dual-source competitive production from production Lot I; and, most manageable by government.¹¹

In conjunction with ASAP philosophy, many items have been included in the ongoing POP phase which would normally be done later in the D/PP phase (FSD). These include integrated logistics planning, producibility engineering planning studies, and generation of design-to-unit-production-costs (DTUPC) goals. Also, the government will obtain full rights and data for hardware and software to manufacture spare parts.

The current POP contract is a CPAF contract while the D/PP contract, scheduled to be awarded in August 1989, will be a CPIF contract. "The CPAF contract is one that provides for a fee consisting of a base amount fixed at inception of the contract and an award amount that the contractor may earn in whole or part during performance which is sufficient to provide motivation and excellence in such areas as quality, timeliness, technical ingenuity, and cost effective management."¹² The CPIF is contemplated for D/PP to maintain low-contractor risk. The Army anticipates program risk will be reduced to the extent that fixed-price contracts can be awarded to dual sources during production. Multiyear contracting will be considered at that time.

Similarities

There are similarities between the AAWWS and T800 programs as far as which contract areas are emphasized. Just as with the T800, this radar development program emphasized production competition, configuration management, integrated logistics support, MANPRINT, reliability/maintainability, quality and warranties.

The main differences between the two programs are type of contracts awarded, amount of competition involved, and level of risk accepted by contractors and the Army. While both programs involve teaming arrangements, there is growing concern among some observers that teaming is, in itself, detrimental to the acquisition process. Recent articles contend that teaming is a dangerous policy that will drive up costs, level technological innovation, and create powerful political forces.¹³

Experience with the AAWWS system shows that acquisition strategy involving teaming is cumbersome and, perhaps, more expensive in some cases (estimated 3 percent cost of teaming). This is the price to be paid when, due to fiscal constraints, competition throughout development is not affordable, as was the case with the T800. This strategy is one of compromise since it is not affordable to compete totally, yet it is politically and economically unacceptable based on future production considerations to award a sole-source contract. Contrary to nay-sayer assessments of teaming in the acquisition process, teaming does exert a positive force as evidenced in the T800 and AAWWS programs.

Teaming creates the industrial base for future production competition. It may tend to level technology but it enhances, not hampers, innovation. This is true because properly structured teaming encourages cross-fertilization of members' ideas. Strong points of one enforce weaknesses of the other.

Competitive Teaming

Teaming tends to reduce total life-cycle cost of acquisition. It may drive the cost higher for one particular phase

Teaming creates the industrial base for future production competition. It may tend to level technology but it enhances, not hampers, innovation.

such as the AAWWS program, where sole-sourcing may have been cheaper. However, long-term savings will outweigh near-term expense. Competitive teaming like the T800 full-scale development program can significantly reduce government costs due to the contractor investments put forward and provide the government leverage, due purely to competition.

While it may be true that teaming can create political powerhouses, the government can neutralize much political clout by influencing formulation of the teams. The government must ensure there are no overly powerful teams, which would quickly nullify reasons for teaming.

Summary

The current trend in contracting and the role of the project manager are intertwined and important in developing a contract/acquisition strategy. The government program manager must elect the appropriate contract based on the level of risk involved and consider competition and teaming to

the maximum extent practical. Many initiatives are here to stay, competition and teaming in particular. A good government project manager understands new initiatives thoroughly and learns to live within them to the advantage of the program.

Endnotes

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3. Ibid.
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9. *T800 Engine After Action Report, Lessons Learned*, U.S. Army Aviation Systems Command, Jan. 21, 1987, pp. 1-12.
10. *AAWWS Acquisition Plan*, Sept. 29, 1988, p. 3.
11. Ibid.
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